Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering

(Civil Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester - VII

W.E.F. 2020 – 2021

Syllabus Structure for Fourth Year Engineering (CIVIL) (Semester – VII)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical/Oral		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
PCC CE305 Hydrology & Water Resources Engineering	D	3	-	-	3	40	60	-	-	100	3
PEC Professional Elective Course III	E	3	-	-	3	40	60	-	-	100	3
PEC Professional Elective Course IV	E	3	-	-	3	40	60	-	-	100	3
OEC Open Elective Course III	F	3	-	-	3	40	60	-	-	100	3
PCC CE305 Hydrology & Water Resources Engineering LAB	D	-	-	2	2	-	-	25	25 OR	50	1
PCC CE308: Construction Engineering & Management (LAB)	D	1	-	2	3	-	-	25	25 OR	50	2
PROJ Major Project Stage I	G	-	-	12	12	-	-	50	50 OR	100	6
MC IV Essence of India Traditional Knowledge		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

Professional Elective Course III	Professional Elective Course IV	Open Elective Course III
Remote Sensing	**Prestressed Concrete**	**Solid and Hazardous Waste Management**
Port and Harbor Engineering	**Rural Sanitation**	**Geology for engineers**
Watershed Management	**Advanced Water Treatment Technology**	**Environmental Impact Assessment**
	Hydraulic Modeling	**-**
Advanced steel structural analysis and design	**Geosynthetic engineering**	

Syllabus Structure for Fourth Year Engineering (CIVIL) (Semester – VIII) (Civil)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical/Oral		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
PCC CE309: Engineering Economy, Estimation & Costing	D	3	-	-	3	40	60	-	-	100	3
PEC Professional Elective Course V	E	3	-	-	3	40	60	-	-	100	3
PEC Professional Elective Course VI	E	3	-	-	3	40	60	-	-	100	3
OEC Open Elective Course IV	F	3	-	-	3	40	60	-	-	100	3
PCC CE309: Engineering Economy, Estimation & Costing LAB	D	-	-	2	2	-	-	25	25 OR	50	1
PCC CE201 Advanced Surveying (LAB)	D	2	-	2	4	-	-	25	25 OR	50	3
PROJ Major Project Stage II	G	-	-	6	6	-	-	50	50 OR	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

Professional Elective Course V	Professional Elective Course VI	Open Elective Course IV
Advanced Concrete Structural Analysis and Design	**Design of hydraulic structures**	**Operations Research methods and engineering applications**
Hydraulic Machines	**Bridges engineering**	**Biotechnology of waste treatment**
Advanced wastewater engineering	**Theory of elasticity and plasticity**	**Internet of things**
Foundation Engineering	**Industrial wastewater engineering**	**Interior Design**
	Ground improvement techniques	

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Semester - VII

W.E.F. 2020 – 2021

<table>
<tr><td colspan="6" align="center">Hydrology & Water Resources Engineering</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Hydrology & Water Resources Engineering</td><td>Short Title:</td><td>HWRE</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:
Water is the most precious civil engineering entity. Availability of water is an index of nation’s prosperity. The responsibility of a civil engineer is to avail water for drinking, domestic, industrial and irrigation applications, which is the largest consumer of water. This requires identification of water resources, their harnessing techniques, water management and water conservation techniques. Sum total of this forms the syllabus of the present subject. It includes hydrology to assess the flow potentials and to plan the water retaining structures. It also includes the design of after retaining common structures. Topics like water logging, crop water requirements also supplement the subject.</td></tr>
<tr><td colspan="6"></td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The course enables students identifying water resources, plan and design their harnessing techniques.
2. It enables students to plan for water management and water conservation techniques.
3. The student will demonstrate ability use hydrology to assess the flow potentials and to plan the water retaining structures.
4. The students will have an ability to design water retaining common structures.

5. Student will have knowledge of water logging, crop water requirements and water quality criteria for irrigation.

Course outcomes:

After successful completion of this course the student will be able to:

1. Demonstrate phenomena of hydrological cycles and precipitation.
2. Demonstrate soil moisture content, water requirements of crops, quality criterion, water logging etc.
3. Design hydraulic structures like different types of dams and spillways and canals.
4. Select site for construction of water retaining structure and plan a complete mega water resource development project.
5. Understand the socio – economic aspect of water resources projects, their environmental impacts and mitigation measures.

COURSE CONTENT

Hydrology & Water Resources Engineering		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Hydrology: terms and terminology, hydrological cycle, its applications.

Precipitation: forms, measurement, presentation of rain gauge data, mass inflow curves, hyeptograph, average precipitation, optimization of rain gauge numbers.

Concept of evaporation, transpiration, infiltration, factors affecting them, their measurements.

Stream gauging, discharge and stage measurements.

Run off: yield, factors affecting runoff, estimation of runoff using mathematical expressions.

hydrographs: definition, concept, factors affecting its shape, base flow separation.

flood hydro graph, unit hydrograph – definition, derivations, applications, *S* hydrograph.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Ground water hydrology: occurrence and distribution of ground water, yield of acquifers, movement of ground water, Darcy's law, permeability, safe yield of basins, well loss, specific capacity of well, well irrigation and its applications.

Water logging and drainage: causes, preventive measures, curative measures.

Reservoir Planning, storage and diversion works, multi –purpose reservoir projects, investigations for locating a reservoir, mass curve and its use for estimation of required storage, economic aspects, B/C ratio.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Reservoir sedimentation: process of erosion, introduction to suspended and bed loads, critical tractive force, trap efficiency, life of reservoir, factors affecting silting, and control measures.

Irrigation: necessity, benefits, ill effects, methods.

Soil – water – plant relationship, classification of soil water, saturation capacity, field capacity, quality of irrigation water.

Crop water requirements, limiting soil moisture conditions, depth of irrigation water and frequency, principal Indian crops and their seasons, base period, duty of water and delta, factors affecting, duty and delta. Methods of improving duty. Intensity of irrigation, paleo irrigation, kor depth, kor period, outlet factor, capacity factor, time factor, crop ratio, overlap allowance, calculation of canal capacity, application of water.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Types of dams, reservoir storage zones, site selection for dams, choice of dam, economical height of dam.

Diversion head works: functions, types, site selection, types, and components.

Gravity dam: cross section, elementary and practical profile of dam, forces acting on gravity dam, modes of failure, introduction about infiltration gallery.

Introduction to arch dams, their types, suitability.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Earth dams: types, elements, basic design considerations, causes of failure, piping and its control, control of seepage, drainage in earth dam.

Spill ways: capacity, types, their suitability.

Gates: uses, types.

Canal irrigation: types of canal, canal alignment.

Losses in canals, schedule of area statistics.

Text Books:

1. Irrigation engineering and hydraulic structures by S K Garg, Khanna Publications.
2. Irrigation and water power engineering by B C Punmia, Laxmi Publications.
3. A Text book of hydrology and Water resources, by R K Sharma, Dhanpatrai Publications.

Reference Books:

1. Irrigation, water resources and water power engineering by P N Modi, Standard Book House Publication.
2. Theory and design of irrigation structures, Vol I and II, Varshney R S, Gupta S C and Gupta R L, New Chand and Brothers Publication, Roorki.

<table>
<tr><td colspan="6">Remote Sensing (Professional Elective Course - III)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Remote sensing</td><td>Short Title:</td><td>RS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course introduce the students about concept in Remote Sensing such as scope and application of remote sensing in civil engineering, Importance of remote sensing in geology and geomorphology, Principles of remote sensing and its methods, Scope and application of photo graphrammetry in identification of soil mapping, Use of mirror stereoscopes parallax bar in interpretation of aerial photos, Interpretation techniques in satellite imageries.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. Indentify and calculate the theory of errors in measurement in Triangulation survey
2. To use an Mirror stereoscope to interpret aerial photos.
3. Calculate air base distance, overlap, and height of object in photographs.
4. Relate the knowledge gained after using parallax bar in photographs survey..
5. To relate the knowledge about remote sensing for soil mapping

Course outcomes:

After successful completion of this course the student will be able to:

1. To be able to interpret and analyze aerial photos and satellite imageries.
2. To be able to process aerial photos with respect to overlap and tone lithology.
3. To be able to apply knowledge of interpretations techniques of remote sensing for air photo interpretations and processing
4. To be able to apply knowledge of remote sensing in civil engineering projects.
5. To be able to apply knowledge of remote sensing in areas of geological aspects of foundation in civil engineering projects

COURSE CONTENT

Remote Sensing		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3hours/week**	**End semester exam (ESE):**	**60**
		Duration of ESE:	**03**
		Internal Sessional Exams (ISE):	**40**

Unit–I:	**No. of Lectures: 09 Hours**	**12**

Introduction to Remote Sensing :

Basic principles ,definition , importance , scope brief history of remote sensing, sensors and its classifications ,platforms ,electromagnetic radiation and spectrum multispectral scanner MSS, black body radiation ,atmospheric windows, Types of satellite, their uses, imageries and their uses. Thermal infra red radiation techniques of Remote sensing. GIS and its components and applications, GPS and its applications with mapping.

Unit–II:	**No. of Lectures: 09 Hours**	**12**

Photogrammetry:

Objects, application to various fields , terrestrial photogrammetry and aerial photogrammetry, aerial camera, comparison of map and vertical photographs, classification of photographs , concept of principal point, nadir point, isocentre, horizon point, principal plane , Scale of vertical photograph ,computation of length and height from the photograph, relief displacement on vertical photograph , Mirror and lens stereoscopes, parallax bar, flight mission ,types of films, print and diaposities.

Unit–III:	No. of Lectures: 08Hours	12

Interpretation Techniques :

Fundamentals of Image interpretation ,Photo recognition elements , like tone , texture , lineaments and its types , factors affecting aerial photo interpretation , determination of scale height slope stereoscopic exaggeration aerial mosaics, annotation of mosaics, role of remote sensing in the detection of temporal changes,

Unit–IV:	No. of Lectures: 08Hours	12

Applications in Civil Engineering:

Aerial photo interpretation in major civil engineering projects like Dam sites, landslide investigation route location , Tunnels, Town planning, investigation in construction material , Terrain studies and soil mapping with the help of remote sensing techniques application in metrological interpretation , agriculture, forest areas, environmental studies .

Unit–V:	No. of Lectures: 08Hours	12

Application in Geology and Geomorphology :

Lithological interpretation ,recognizing igneous, sedimentary, metamorphic rocks on aerial photographs and satellite imageries , structural interpretation determination of strike, dip, joints , fractures , faults, folds, dykes and unconformity ,remote sensing application in ground water , surface water delineation, study of floods , drainage analysis ,drainage patterns ,density, frequency, landforms of types of rocks , landforms of structural features

Text Books:
1 Wolf R R , Elements of photogrammetry , McGraw Hill ,Tata McGraw Hill pub co. Ltd New Delhi **2** Campbell J B ,Introduction to remote sensing , The Guilford press London. **3** Mehrottra , Suri R K , Remote sensing for environmental and forest management , Indus publication , New Delhi. **4** Miller V C , Photogeology, McGraw Hill ,Tata McGraw Hill pub co. Ltd New Delhi
Reference Books:
1 Patel A N ,Surendra singh, Remote Sensing Principles and applications 2 Thornbary W B, Principles of Geomorphology , John wiley and sons. 3 Sabnis F F, Remote sensing principles and interpretation. 4 Kennine T J M, Methews M C, Remote Sensing in Civil Engineering. 5 Panday S N, Principles of Remote Sensing.

Port and Harbor Engineering (Professional Elective Course - III)

COURSE OUTLINE

Course Title:	**Port and Harbor Engineering**	**Short Title:**	*PHE*	**Course Code:**	

Course description:

Transportation facilities ensure the prosperity, security and integrity of a nation. Water transport is an ancient and conventional mode of transportation. A civil engineer is supposed to create dock, harbors and port facilities for the water ways particularly through sea. This course enables a student to plan design and execute a waterway project.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The basic objective of this course is enabling a student to plan, design and execute a waterway project.
2. The student must be able to carry out required marine surveys.
3. The students must be able to do design of the Docks, Harbour and port using available material and execution of the project.
4. The student must also be able to design water traffic signaling network using most advanced technology.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the importance of transportation system in the development of a country, classification of Docks, Harbours and ports planning in India.
2. Demonstrate ability to carry out marine survey required for the Docks Harbours and ports.
3. Demonstrate ability to decide a Harbour geometry depending upon the anticipatory traffic and Structural design of Docks, Harbours and Ports.
4. Execution of a waterway project.
5. Installation, commissioning and maintenance of advanced signaling system and maintenance of Docks Harbors and Ports.

COURSE CONTENT			
Docks Harbours and Ports		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Harbours and Ports:

Significance and history of water ways, Importance of Harbours and ports for inland water ways and sea routes. Classification of harbours and ports based on situation, location and their utility. Site selection criteria for harbours and ports, process for site selection for harbors and ports, Effects of winds, waves and tides on site selection.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Requirements of Good Harbours**,** Accessibility and size of Harbours, shape of Harbours, Harbour Depth, Features of harbours, Layout of harbours

Planning and design of Harbours: Area for free movement and depth requirements depending upon size of vessel, harbour entrance, entrance channel, light house, design of facilities for Parking, loading and unloading.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Ports: functions of port, Requirement of good ports, design of ports, Environmental impact of ports.

Break waters: Introduction, Alignments Of Break water, Forces acting on break water, classification of break water, points to be observed in connection with the construction of vertical break water. Advantages of vertical wall break water, materials used in design of break waters, principles of design of break waters, safety and maintenance aspects.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Docks: Introduction, functions of docks, classification of Docks, Tidal basin, river ports, form and arrangement of basins and docks, excavation for docks and basins, shape of dock and basins, location of dock.

Design and construction of dock**,** dock entrances, types of caissons for dock entrances, size of dock entrances, forces to be considered and materials to be used, design principles.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Dry or Repair Docks: Introduction, Repair arrangements, classification of dry docks, floating dry docks, marine railway dock, lift dry dock. **Dry or Graving Dock:** sequence of operation of dry dock, size of dock, forces acting on dry dock, design consideration, design of dry dock floor, construction of dry docks.		
Text Books:		
1. *B.L. Gupata, and Amit Gupta "Road, Railway, Bridges, Tunnels & Harbour Dock Engineering,* Standard Publishers Distributors *2.* Hasmukh P. Oza and Gautam H. Oza " *Dock & Harbour Engineering"* Charotar Publishing House Pvt. Ltd.		
Reference Books:		
1. R. Srinivasan "*Harbour Dock and Tunnel Engineering"* Charotar Publishing House *2.* S.P. Bindra "*Docks and Harbour Engineering*" Dhanpatrai Publications Pvt Ltd, New Delhi.		

Watershed Management (Professional Elective Course - III)					
COURSE OUTLINE					
Course Title:	*Watershed Management*	**Short Title:**	*WSM*	**Course Code:**	

Course description:
This course is designed to enable student to asses, apply and analyze the relevant geological , ground water, irrigation principles . In this course , the topics on morphology, groundwater , irrigation pollution, agriculture , issues in irrigation , appraisals, rain water harvesting urban watershed management are mainly to highlight for the relevant basic knowledge . Students acquainted with related knowledge can be able to apply in design and economics of watershed projects.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	*14*	*42*	*3*

Prerequisite course(s):
Irrigation , Engineering Geology , Environmental pollution , Ground water
Course objectives:
With successful completion of this course , the student should have the capability to : 1. Students aware about importance of conservation of water and its management 2. Design , issues , appraisals used for watershed management 3. To aware about geology and groundwater regarding strata to infiltrate water
Course outcomes:
After successful completion of this course the student will be able to:

1. To identify and predict the watershed areas and its characteristics.
2. To evaluate the factors with respect to groundwater , rain water
3. To predict the water resource appraisal of watershed area
4. To be able to predict soil and water conservation
5. To be able to interpret planning and management of Urban watershed

COURSE CONTENT			
Watershed Management		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**
Concept of watershed : Introduction ,importance of geology , significance of watershed based development, watershed characteristics, geomorphology and hydrology, Drainage basin network morphology		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Watershed Hydrology : Hydrological cycle water balance , climate and precipitation , soil and infiltration, interception and evaporation , evapotranspiration , groundwater stream flow and runoff , aquatic ecosystem		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Watershed Resource Appraisal : Physical ,hydrological and land use , land cover, ,land capability classification , watershed management planning and objectives.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Issues in water resources : Point and agriculture and urban non point source pollution , soil conservation and water conservation measures ,Erosion , water scarcity , flooding, drinking water protection , Benefit cost analysis.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Urban watershed Management: Green roof, rain water harvesting from urban structures, Urban watershed management, goals and strategies, sustainability and Urban watershed management Urban storm water pollution.		
Text Books:		
1 Murthy, J V S (1994) , Watershed Management in India, Wiley Eastern Ltd New Delhi 2 Paranjape S and others (1998), Watershed based Development , Bharat Gyan Vigyan Samithi , New Delhi. 3 K. Subramanya, Engineering Hydrology, McGraw Hill Education		
Reference Books:		
1 Todd , Groundwater,Tata McGraw Hill pub co. Ltd New Delhi 2 Mutreja K N (1990), Applied Hydrology ,Tata McGraw Hill pub co. Ltd New Delhi 3Sinha R J (2000) ,Water planning and management , Yash publication House , Bikaner 3 Hoan C J , Hydrology and small watersheds .		

<table>
<tr><td colspan="6">Advanced steel structural analysis and design (Professional Elective Course - III)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Advanced steel structural analysis and design</td><td>Short Title:</td><td>ASSAD</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Steel structures are getting popularity for special industrial applications, bridges and high rise structures. They are preferred owing to their higher strength, speedy construction and reliability. The present syllabus includes special steel structures like gentry girders, plate girder, water tanks, chimneys, towers, foundations with base plates etc. the syllabus confirms to IS 800 – 2007, IS 875 for wind force analysis and IS 1893 for earth quake analysis.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. This syllabus is aimed to appraise a learner with types of advanced steel structures
2. It describes their uses, their design principles, procedures, construction methodologies and maintenance requirements.
3. The learners must be able to analyze and design special steel structures like water tanks, chimneys, towers, foundations, plate girders, gentry girders etc.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze and design bolted and welded connections.
2. Analyze and design beam, purlins, and castellated beams with different support conditions.
3. Analyze and design girder and trusses.
4. Analyze and design different types of steel chimneys.

<table>
<tr><td colspan="6">5. Analyze and design different types of steel water tanks.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE CONTENT</td></tr>
<tr><td colspan="2">Advanced steel structural analysis and design</td><td colspan="2">Semester:</td><td colspan="2">VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td colspan="3">End semester exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="3">Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
<tr><td colspan="2" align="center">Unit–I:</td><td colspan="2" align="center">No. of Lectures: 09 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Connections:
Bolted connections: Tpes of fasteners, types of joints, rigid connections, semi rigid connections bolt value, efficiency of joint, analysis and design of bolted connections.
Welded connections: introduction, types of weld, analysis and design truss members connections, framed connections, stiffened and unstiffened seat connection.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2" align="center">Unit–II:</td><td colspan="2" align="center">No. of Lectures: 09 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Design of Beams:
Introduction, Types of sections, lateral stability of beams, Builtup beams,Bending stress, bearing stress, web buckling, web crippling, diagonal buckling. Design of laterally supported and unsupported beams, design of purlins.
Castellated beams - Concept, fabrication of the castellated beam from rolled steel
section, Effect of hole in beam. Design of castellated beam for bending and shear as per codal provisions by limit state method.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2" align="center">Unit–III:</td><td colspan="2" align="center">No. of Lectures: 08 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Girders:
Introduction, types of sections, elements of plate girder, proportioning of web and flanges, self weight, curtailment, types of stiffners, design of welded plate girder. Analysis and design of gantry girder.</td></tr>
</table>

Truss: Introduction, components, Load combinations, analysis and design of roof truss.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Chimney: Introduction, type, joints, lining, ladder, forces acting on chimneys, design of thickness of steel plates for self supporting chimney. **Chimney Foundation:** Design of base plate, anchor bolt and foundation, stability of steel chimneys.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Water Tanks: Introduction, permissible stresses, Thickness specifications, Stiffening angle, stand pipe, Elevated tanks, Circular tanks, rectangular tanks, wind force, earthquake force, Design of elevated rectangular and circular tanks, design of staging.		
Text Books:		
6. Shah and Veena Gore, Limit State Desin of Steel Structure, Structures Publication. *7.* S.S. Bhavikatti, Design of Steel Structure, *I. K. International Publishing House*		
References Books		
1. Ram Chandra, Design of steel Structures, Volume II, Standard Book House, Delhi. 2. Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, Delhi. 3. M Raghupathi, Design of steel structures, Tata McGraw Hill, New Delhi. 4. S K Duggal, Limit state design of steel structures, Tata McGraw Hill Education. 5. N Subramanian, Design of steel structures, Oxford University Press. 6. Sarwar Alam Raz—Structural Design in Steel---New Age International Publishers 7. IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi. 8. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi. 9. IS: 875-2015 Code of Practice for wind analysis 10. IS: 1893-2016 Code of Practice for earthquake analysis		

Prestressed Concrete (Professional Elective Course - IV)

COURSE OUTLINE

Course Title:	***Prestress Concrete***	**Short Title:**	PC	**Course Code:**	

Course description:

This course is intended to provide the engineering student with the basic tools required to design and build prestressed concrete structures. Emphasis will be placed on the behavior of prestressed concrete under load along with potential failure mechanisms

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The main objective of this subject is to develop an understanding of the basic principles of prestressed concrete structures analysis and design.
2. To illustrate students with the analysis and design of prestressed concrete building members, either in theoretical side of view or in analytical step-by-step procedures to enable students to make an easier transition from theory to problem solving.

Course outcomes:

After successful completion of this course the student will be able to:

1. Know basic concepts of pretressed concrete, system of prestressing, and losses in prestress.
2. Understand the design of prestess beam, concept of sher and deflection.
3. Design of Tension and Compression members and End Block.

4. Concept and design of continuous beam, circular tanks and pipes, concrete composite beam.
5. Concept and design of prestressed concrete piles, poles and pavement.

COURSE CONTENT

		Semester:	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

1.General principles of prestressed concrete members:

Introduction- definition-need of prestressing-use of high strength concrete-use of high tensile steel-assumptions-stress concept-beam with concentric tendon-effect of loading on the stress in the tendons- beam with eccentric tendons-effect of loading on the stress in the tendons-beam with bent tendon- beams of rectangular, T and I sections-the pressure line – C – line and P – line –strength concept – review of different techniques.

2.System of prestressing:

Classification of prestressed concrete members – externally and internally prestressed members- linear prestressing pretensioning post-tensioning- bonded and unbonded tendons-the hoyer system – the Freyssinet system- The magnel blaton system-The Gifford Udall system-C.C.L. standard system-The Lee – Mccall system.

3.Loss of prestress:

Losses of prestress at various stages – loss of stress due to length and curvature effects – loss of stress at the anchoring stage – loss of stress due to shrinkage of concrete- loss of stress due to creep of concrete – loss of stress due to elastic shortening of concrete – loss of stress due to creep in steel.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

1.Design of Prestressed concrete beams:

Simply supported beams – design principles- I.S. Recommendations - permissible stresses – various stages of analysis – lever arm conception – P and C lines – kern distance – Rectangular and I sections.

2. Shear:

Shear stresses – principle tensile stress – shear reinforcement – vertical prestressing – shear stresses and principle stresses due to torsion.

3.Deflection of prestessed concrete members:

Need to determine deflections – short term deflection – deflection caused by tendon – deflection caused by loads – long time deflection – permissible deflection.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

1. Tension and Compression members

Tension members – various approaches-design principles – strains in prestressed concrete tension members – tension members designed on cracking and ultimate strength consideration- compression members – direct loading – direct loading and bending – design principles.

2.End block

Introduction – stresses in the end block – spalling and bursting stresses – transmission zone – magnel's method – Horizontal, vertical and shear stresses – Guyon's method – anchor plate – Anchor plate placed symmetrically – anchor plate placed eccentrically – end block with anchor plates I.S. recommendations.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

1.Continous beams

Important conceptions- The P – line and C – line – Primary moment – secondary moment – analysis of prestressed concrete continuous beams – concordant cable profile- linear transformation – non – concordant cable profile – design consideration – designs 101 to 109

2.Prestressed circular tanks and pipes

Introduction – composite construction – unpropped method – propped method – I.S.

recommendations – shrinkage stresses – designs 110 to 112

3. Prestressed concrete composite beams

Introduction - composite construction – unpropped method – propped method – I.S. recommendations – shrinkage stresses – designs 112 A to 118

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

1. Prestressed concrete piles:

Introduction – handling stresses in a pile – need for prestressing – maximum length of pile.

2. Prestressed concrete pole:

Introduction – handling stresses in a pile – need for prestressing –Analysis for bending moment.

3. Prestressed concrete pavements:

Need for prestressing pavement slabs- stresses in pavement slab- longitudinal and transverse cables – oblique cables – designs.

Text Books:

1. Prestressed Concrete by S. Ramamrutham, Dhanpat Rai Publishing Company.

2. Prestressed Concrete by N. Rajagopalan, Narosa Publishing House.

3. Prestressed Concrete by N. Krishna Raju, The McGraw Hill Companies.

Reference Books:

1. Design of Prestresssd Concrete Structures by T. Y. Lin and Ned H. Burns, Willey Publisher.

2. Analysis and Design of Prestressed Concrete Structures by Dr. Hussam, https://www.researchgate.net/publication/328202827_Analysis_and_Design_of_Prestressed_Concrete_Structures.

<table>
<tr><td colspan="6">Rural Sanitation (Professional Elective Course - IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Rural Sanitation</td><td>Short Title:</td><td>RS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">With the advent of the Prime Minister Narendra Modi's thought of making the country Open defecation free till 150th birth anniversary of Mahatma Gandhi, the concept of rural sanitation garnered loads of interest in local, national as well as global arena. On the sidelines of this statement this course is designed for the students so as to make them aware about the Rural Sanitation by virtue of which the can design various units of water supply and waste treatment in a judicious manner. The syllabus gives emphasis to the low cost technology which may be employed to rural areas with minimal maintenance requirement.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Nil

Course objectives:

The Objectives of course:

1. To make aware the students about schemes, practices and policies locally as well as globally in pertinent to the Rural sanitation.
2. To select an appropriate Treatment and disposal technique that is economically feasible and is viable in rural areas where maintenance facilities are limited. .

Course outcomes:

After successful completion of this course the student will be able to:

1. Be able to identify and understand rural issues of water supply and sanitation.
2. Acquiring skills and understanding about the development of these projects with cost effective
implementation and operation & maintenance.
3. An ability in effective resource planning for rural environmental projects.
4. To optimize the treatment and disposal of processes in pertinent to rural sanitation.
5. To analyze the Distribution network of rural areas analytically and by use of software.

COURSE CONTENT

Rural Sanitation		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction:

Concept of Sanitation, its history and scope in rural areas, Problems of Rural water and Sanitation in local as well as global arena, Population to be covered, Awareness of national schemes and Policies in pertinent to the Rural Sanitation, Awareness of international schemes and Policies in pertinent to the Rural Sanitation, Interpretation of any one case study in pertinent to the development of Rural Sanitation augmenting the implementation of its schemes and policies.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Selection and development of Preferred Sources of water for Rural Sanitation:

Springs, Wells, infiltration wells, radial wells and infiltration galleries, collection of raw water from surface source, Specific practices and problems encountered in rural water supply, Rainwater Harvesting, Groundwater Recharge, Numerical Problems on Design of Wells in confined and unconfined aquifer, Numerical Problems on Design of Rain water Harvesting system for Rural Sanitation, Quality of surface and sub surface water sources in pertinent to the rural sanitation.

Planning of water supply system:

Design population and demand loads. Various approaches of planning of water supply schemes in rural areas.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Specific Problem in rural water supply and Treatment:

Source Sustainability, Slippage, Water Quality, Operation and Maintenance. Low cost treatment, appropriate technology for water supply and sanitation augmented with flow charts, Numerical on Design of units of a rural water treatment plant.

Improved methods and compact systems of treatment:

Brief Details of multi-bottom settlers (MBS), diatomaceous earth filter, cloth filter, slow sand filter, chlorine diffusion cartridges, Water supply during fair, festival and emergencies, Numerical on design of Diatomaceous earth filter and slow sand filter.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Treatment and Disposal of Rural Waste:

Community latrines: Different types and location of latrines, various methods of collection and disposal of night soil, Simple waste water treatment units and systems in rural areas such as stabilization ponds, septic tanks, Imhoff tank, soak pit etc. Disposal of waste water soak pits and trenches, Numerical on design of community laterines, Numerical on design of units of wastewater treatment plant units for rural areas (Stabilization Ponds, Septic tanks, Imhoff tank, Soak pits and trenches), Disposal and characteristics of Solid Wastes, Composting, land filling, incineration, rural health, Other specific, issues and problems encountered in rural sanitation, Numerical on Evaluation landfill gases concentration, Numerical on design of domestic landfill for rural areas.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Analysis and Optimization of distribution networks:

Concept of distribution network for rural sanitation, Hardy Cross Method, Hazen William Equation, Use of computing techniques to analyze a rural distribution network (for water and wastewater) viz. BRANCH Software, LOOP Software and EPANET Software and Numerical based on it, optimization by Linear and Dynamic programming with Numerical treatment.

Economic Analysis of Rural Sanitation Project:

Terminologies in pertinent to the Economic Analysis augmented with basic concepts and equations, Methods of Economic Analysis: Net Present Value, Payback Period, Benefit Cost Ratio Analysis and Numerical based on it.

Biogas plants:

Definition, Objective, Methodology and Construction, operation and Maintenance, Economic analysis, Benefits, Shortcoming

Text Books:

1. Low cost waste water treatment technology, Trivedi R. K., Kaul S., ABD publications, Japan 2001.

2. Wastewater treatment for pollution control and reuse by S J Arceivala, S R Asolekar, TMH publication.

3. Wastewater Engineering-Treatment, disposal, reuse Metcalf & Eddy 4th Edition 2003. Tata McGraw Hill International Editions.

Reference Books:

1. Rural Water Supply in developing countries, International development research centre.

2. Water supply for rural areas and small communities, Publication W. H. O. Geneva, 1959.

3. Rural water supply and sanitation, Wright Forest b., second Edition, Wiley Eastern New Delhi 1956.

4. CPHEEO Manual of Water Supply and Treatment, 1999, Ministry of Urban Development.

6. CPHEEO Manual of sewerage and Sewage Treatment, 1993, Ministry of Urban Development.

7. Integrated solid waste management. Tchobanoglous, Theissen and Vigil-McGraw Hill Book Co.

8. CPHEEO Manual of Solid Waste 1993. Ministry of Urban Development.

Advanced Water Treatment Technology (Professional Elective Course - IV)

COURSE OUTLINE

Course Title:	Advanced Water Treatment Technology	**Short Title:**	AWTT	**Course Code:**	

Course description:

Purity of water is the first step of hygiene. In fact for all drinking, domestic, industrial and agricultural applications require wholesome water, not distilled water. Wholesomeness of water being supplied by the municipal corporation is an important index of living standard. It is the responsibility of a civil engineer to ensure adequate and safe water being supplied to the people. The under graduate course in civil engineering already includes a basic course related to water supply engineering. The present syllabus is next step to that. It takes the student for in depth knowledge of physic – chemical processes, and their mathematical modeling.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. This course enables a student to look into the physico – chemical process involved in the water treatment technology not as a black box phenomenon but with a rational perception.
2. This course helps student to develop a scientific insight into the process and operations going on in water treatment engineer.
3. This helps engineering graduate to not only plan, design, erect, commission, operate, maintain and trouble shoot a water treatment plant, but also to augment it for taking into account waters with special needs.

Course outcomes:

After successful completion of this course the student will be able to:

1. Plan and Design a water treatment plant with all accessories and Erect, maintain, commission, operate and trouble shoot a water treatment plant.
2. Demonstrate and ability to describe physic – chemical process of water treatment.
3. Augment a water treatment plant for growing needs.
4. Augment a water treatment plant for water with special needs.
5. Conduct pilot plant and bench scale research activities on water treatment process.

COURSE CONTENT

Advanced Water Treatment Technology		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Quality of water: Standards of raw and treated waters by WHO and relevant IS codes. Significance of acceptable and cause of rejection limits. Physical, chemical and biological parameters in water, standard methods for examination of water for relevant parameters. Sources of water and their natural quality. Protection of water resources. Effects of water quality on human life. Water ecology. Water demand analysis and its fluctuation.

Changing characteristics of water with time.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Water treatment: Requirements of water treatment facilities. Functional design and hydraulic design concept. Unit operations and process. Types of reactor according to hydraulic regime and their suitability. Reactors in series and parallel. Dye tracing of reactors to identify their hydraulic regime. Efficiency of reactors.

Sedimentation and flotation: General equation for settling or rising of discrete particles. Hindered settling. Effect of temperature, viscosity. Efficiency of an ideal settling basin, Reduction in efficiency due to various causes. Sludge, Storage and removal. Design criteria of

settling tanks. Numerical treatment for sedimentation tank design. Problems in maintenance of sedimentation tanks. Their remedy. Tube settles and plate settles.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Coagulation: theory of chemical coagulation, common coagulants, their chemistry, factors affecting their performance, coagulation aids. Mixing arrangement design of mechanical flocculator. Mean velocity gradient. Design of facilities for chemical coagulation. Filtration: Theory of filtration. Mechanism, of filtration, Size & shape characteristics of filter media. Preparation of filter sand. Hydraulics of filtration through homogenous and stratified media. Hydraulics of filter washing. Design of filter elements. Filter appurtenances. Filter stratification problem. Multimedia filters.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Water born diseases, sources of pathogen in water, disinfection methods, selection of chlorine, chemistry of chlorine, its limitations and bad effects. Break point chlorination and de-chlorination. Hardness: sources, cause, acceptable and rejection limits, bad effects, methods of determination. Methods of removal – lime soda process, zeolite process. Their theory, design and applications.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Aeration of water: necessity, theory, methods. Design of facility for aeration. Adsorption: necessity, common sorbents, theory of adsorption, kinetics – Langmuir isotherm, Frendlich isotherm, BET isotherm. Introduction to osmosis. Membranes used. Photo catalysis and its application in water purification, theory of photo induced oxidation and factors affecting it under slurry phase process. Future of photo catalytic treatment of water. Fluoride removal- Introduction, removal of taste and odor. Control of algae in water resources.		

Text Books:
1. Water supply and sewerage by E W Steel, Terence J Mc Ghee International Student's edition. 2. Advanced Water Treatment by Mika Sillanpaa, Elsevier publication.
Reference Books:
1. Physico chemical treatment processes for water treatment, Walter J Weber

Hydraulic Modeling (Professional Elective Course - IV)					
COURSE OUTLINE					
Course Title:	*Hydraulic Modeling*	**Short Title:**	*HM*	**Course Code:**	

Course description:

This syllabus introduces a learner with the basic principles of hydraulic modeling, its procedures, applications and limitations. It describes the common modeling techniques of ground and surface water flow using simulations and IT assistance and its uses in civil engineering. The syllabus is useful for watershed management engineer, water resources engineer and ground water engineer. The applications are there in environmental science and geology also.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

Prerequisite course(s):

Nil

Course objectives:

The requisite objectives needs to be fulfilled are as follows:

1. To Understand the Concepts of Watershed and its Management.
2. To appreciate the meaning and significance of hydraulic modeling.
3. To Identify and define a hydraulic water resource Problem.
4. To Model and analyze the Hydraulic water Problem by using an appropriate method.

Course outcomes:

After successful completion of this course the student will be able to:

1. Develop a skill of choosing the correct management techniques for water resources.

2. Formulate problems, gather data, generate and prioritize a set of alternative solutions, and

select and implement the best alternative.

3. Demonstrate the principles of remote sensing and GIS to the water resources for management.

4. Model and optimize the Hydraulic Problem.

5. Model a Water resource Problem by Soft Computing Methods.

COURSE CONTENT				
Hydraulic Modeling		**Semester:**	*VII*	
Teaching Scheme:		**Examination scheme**		
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Environmental and water resources problem: Watershed-element and types, Watershed hydrology, Hydrological cycle, Precipitation, water losses , Runoff , Rainfall-Runoff analysis, Watershed problem.

Water Resources Management:

Erosion control and watershed development: their benefit towards conservation of national water wealth. Rain water harnessing and recharge of ground water: role of society and people's participation for sustainable water resource development. Mitigation strategies for flood damage: structural and non-structural measures.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Watershed Management techniques

Spatial Decision Support Systems (SDSS) for land and water management at the watershed scale, Integrated Watershed Management, On-site and off-site management structures for soil and water conservation. Community Watershed Management.

Optimization

Optimization Multi - objective optimization, Review of probability theory, Uncertainty and reliability analysis, Stochastic optimization - Chance constrained LP, Stochastic DP with applications, Surface water quality control.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Simulation

Simulation – Reliability, Resiliency and Vulnerability of water resource systems, Multipurpose reservoir operation for hydropower, flood control and irrigation, Groundwater Systems, Water quality modeling, River basin Planning and management, Advanced topics.

Soft computing techniques

Soft computing techniques ANN Genetic algorithms, Multi criteria decision making, Decision Support Systems, Expert Systems

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Surface flow modeling techniques: Hydrological and hydraulics flow model, Reservoir routing, channel routing, general operation of flood forecasting, forecasting methods adopted in India, forecasting by unit hydrograph method, Numerical modeling.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Subsurface flow modeling techniques: Concept, definition and expression for yield, transmissibility, Darcy’s law for flow through porous media, its applications in practical problems of confined and unconfined aquifers, Dupuit’s theory of unconfined flow, steady flow towards fully penetrating wells in case of confined and unconfined aquifers, scope and applications of the theory, limitations, Numerical modeling based upon the theory.

Text Books:

1. S. K. Som, G. Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Education, Third Edition, 2013
2. Dr P. N. Modi & Dr. S. M. Seth, Hydraulics and Fluid Mechanics including Hydraulic Machines,

Standard Book House, Twentieth Edition, 2015 3. Bansal, R. K., A textbook of fluid mechanics and hydraulic machines, Laxmi Publications, Revised Ninth Edition, 2010
Reference Books:
1. Miroslav Nechleba, Hydraulic Turbines, ARTIA Prague 2. J. Stepanoff, Centrifugal and Axial flow Pumps, John Wiley & Sons, Inc., Second Edition, 1993 3. Igor J Karassik & Roy Carter, Centrifugal Pumps, McGraw – Hill 4. S. M. Yahya, Turbines Compressors and Fans, Tata McGraw – Hill, Fourth Edition

<table>
<tr><td colspan="6" align="center">Geosynthetic Engineering (Professional Elective Course - IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Geosynthetic Engineering</td><td>Short Title:</td><td>RS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course introduce the students about concept in Geosynthetic Engineering such as Design with geosynthetic materials used in geotechnical applications, design with geogrids, design with geomembranes, design with geonet, design with and geo-composites.</td></tr>
</table>

<table>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester credits</td></tr>
<tr><td>03</td><td>14</td><td>42</td><td>03</td></tr>
<tr><td colspan="5">Prerequisite course(s):</td></tr>
<tr><td colspan="5">Nil</td></tr>
<tr><td colspan="5">Course objectives:</td></tr>
<tr><td colspan="5">1. To understand the emerging trends of Geosynthetic in Geotechnical Engineering
2. To evaluate the different properties by different tests
3. To analyze the functions of geosynthetic and its suitability
4. To design different structures using geosynthetics according to various applications</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Course outcomes:</td></tr>
<tr><td colspan="5">After successful completion of this course the student will be able to:</td></tr>
<tr><td colspan="5">1. Select different geosynthetics for intended purpose
2. Evaluate properties of geosynthetics.
3. Design geosynthetics for intended purpose.
4. Apply geocomposite systems to solve contemporary geotechnical problems</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5" align="center">COURSE CONTENT</td></tr>
</table>

<table>
<tr><td>Geosynthetic Engineering</td><td>Semester:</td><td>VIII</td></tr>
<tr><td>Teaching Scheme:</td><td colspan="2">Examination scheme</td></tr>
</table>

Lectures:	**3hours/week**		**End semester exam (ESE):**	**60**
			Duration of ESE:	**03**
			Internal Sessional Exams (ISE):	**40**
Unit–I:		**No. of Lectures: 09Hours**	**12**	
Introduction: An overview on the development and applications various geosynthetics - the geotextiles, geogrids, geonets, geomembranes, geocomposites and other products Designing with geotextiles: Manufacture of geotextiles, Geotextile properties and test methods – functions - Designing geotextiles for separation, reinforcement, stabilization, filtration and drainage				
Unit–II:		**No. of Lectures: 09Hours**	**12**	
Designing with geogrids: Manufacture of geogrids, Types of geogrids, Geogrid properties and test methods – physical properties, mechanical properties, endurance properties and environmental properties – Designing geogrid for reinforcement in pavements, Retaining walls and bearing capacity				
Unit–III:		**No. of Lectures: 08Hours**	**12**	
Designing with geonets: Manufacture of geonets, Geonet properties and test methods – Physical properties, mechanical properties, hydraulic properties, endurance properties and environmental properties -Designing geonet for drainage				
Unit–IV:		**No. of Lectures: 08Hours**	**12**	
Designing with geomembranes: Geomembrane properties and test methods – physical properties, mechanical properties, chemical properties and biological hazard - Applications of geomembranes and design.				
Unit–V:		**No. of Lectures: 08Hours**		

Designing with geocomposites: Geocomposites in seperation, reinforcement – reinforced geotextile composites – reinforced geomembrane composites – reinforced soil composites using discontinuous fibres and meshes, continuous fibres and three –dimensional cells, Designing for bearing capacity, geocomposites in drainage and filtration
Text Books:
1. Mandal, J.N."Geosynthetics Engineering: in Theory and Practice", Research Publishing, Singapore, 2018 2. Koerner, R.M. "Designing with geosynthetics", Pearson Education Inc., 2012. 3. Rao, G.V. "Geosynthetics – an Introduction", Sai Master Geoenvironmental Services Pvt. Ltd. Hyderabad, 2011.
Reference Books:
1. SivakumarBabu G.L. "An Introduction to Soil Reinforcement and Geosynthetics" University Press, 2009. 2. Jonathan T.W. Wu "Geosynthetic Reinforced Soil Walls" First Edition, 2019 3. Sanjay Kumar Shukla and Jian-Hua Yin, "Fundamentals of Geosynthetics Engineering" CRC Press, 2017, Hyderabad.

<table>
<tr><td colspan="6">Solid and Hazardous Waste Management (Open Elective Course - III)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Solid and Hazardous Waste Management</td><td>Short Title:</td><td>SHWM</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Cleanliness is considered to be an step towards godliness. Hygiene and sanitation are indices of standards of living. India has a history of higher standards of cleanliness which is evident from so many references including the Arthashatra of Kautilya. However, modern India is poor in terms of organized cleanliness mechanism. The authorities have recognized the need of cleanliness programs and have embarked with so many initiatives including Sawchhbharat Abhiyan. The present syllabus includes importance and scope of solid waste management, its methods of solid waste collection, prevailing laws and legislations, methods of transportation of solid waste, methods of recycling and final disposal. Emphasis is given on Municipal solid waste as well as hazardous solid waste also.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

Prerequisite course(s):

Nil

Course objectives:

The Objectives of course:

1. To make aware the students of characteristics, composition, sampling, identification and Management of MSW and Hazardous Wastes.

2. To enable students to select an appropriate Treatment and disposal technique that is economically feasible for the Solid and Hazardous Waste Management.

3. To enable students to plan a comprehensive SWM plan for the municipal corporations.

Course outcomes:

After successful completion of this course the student will be able to:

1. Have knowledge on the sources of Solid and Hazardous Waste along with its characteristics.
2. Design a sampling plan and characterize solid waste.
3. Design transportation network for the SWM, design disposal sites for the SWM.
4. Work out manpower requirements and economic aspects for SWM including recycling.
5. Aware about prevailing legislations in this regard.

COURSE CONTENT

Solid and Hazardous Waste Management		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction:

Concept of Solid Waste, Categories of Solid Waste with sources and its generation, Environmental Impact of Solid waste disposal on land, Composition and characteristics of Solid Waste with Numerical Treatment on each of the Characteristics of Solid Waste.

Municipal Solid Waste Management:

Concept of Solid Waste Management, Objectives of Solid Waste Management, Principles of Solid waste Management, Functional Elements of Municipal Solid Waste Management, Hierarchy of Waste Management options, Components of Municipal Solid Waste Management with an emphasis on linkages of other wastes generated from urban center, Steps involved in the development of a Solid Waste Management System.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Sampling of Solid Waste:

Need for Sampling, Field investigations to be carried out, Sampling Protocols for MSW, Factors affecting waste sampling, Number of samples to be collected as per CPHEEO Manual, Standard procedure for collection of Solid waste Sample, Numerical treatment on Sampling of Solid Waste.

Recycle and Recovery in Solid Waste Management:

Concept of Recovery and Recycle in MSW, Resource Recovery through Material Recycling, Resource Recovery through Waste Processing, Recycling Progress and statistics, Market issues and Purity of Materials.

Mini Research Project on Solid Waste Management:

Students here have to Select a pertinent city/district/taluka as per their choice and fetch the Population data of that city/district/taluka and per capita MSW generated with assistance of Internet (Preferably Census Data or by visiting Municipal Office), Forecast the Population by using appropriate Method augmented with forecasted quantity of solid waste to be generated and devise a Solid Management Plan for that requisite City/District/Taluka.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Sorting of Waste and Material Recovery:

Objectives of Sorting, Stages of Sorting, Concept of Material Recovery and Material Recovery Facility, Sorted Waste Streams, Sorting Operations, Hazards in Sorting and Measures to prevent it, Standard Guidelines for Sorting in pertinent to CPHEEO Manual.

Storage of Solid Waste:

Concept of Storage of Waste, Present scenario and measures to improve it, Steps to be taken by Urban Local Bodies for Storage of Waste and Recyclables.

Collection of Solid Waste:

Concept of Collection of Solid Waste, Present scenario and measures to improve it, Steps to be taken by Urban Local Bodies, Tools and equipment required for the collection of Solid Waste, Methods of Collection of Waste, Collection procedure for different categories of Solid Waste, Automated Waste Collection with aid of GIS Software.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Waste Storage Depots, Transportation of Wastes and Street Cleansing:

Concept of Storage of Solid Waste Storage Depots its Transportation and Street Cleansing, Present scenario and measures to improve it, Steps to be taken by Urban Local Bodies, Methods for different categories of Waste for the same.

Solid Waste Treatment and disposal Technologies:

Principles, Methods and Numerical Treatment for Solid Waste Treatment with an emphasis on Energy recovery if Possible: Composting, Vermi composting, Incineration, Sanitary Landfills, Other emerging Technologies.

Introduction to Hazardous Waste:

Elucidation of Concept of Hazardous Waste with a case study (Ex. Love Canal), Characteristics tests for Hazardous Waste, Generation of Hazardous waste, Transportation of Hazardous Waste, Legislation and Policy Guidelines for Hazardous Waste Management.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Treatment and Disposal of Hazardous Wastes with Numerical Treatment if Possible:

Incineration, Secured Landfill, Neutralization, Chemical Precipitation, Oxidation and Reduction, Sorption Process, Stabilization and Other Methods.

Special Wastes of Importance:

Storage, Collection, Transportation, Treatment and Disposal of: Biomedical Waste, E waste, Construction and Demolition Waste, Industrial Waste, Slaughter House waste.

Legislation on Solid and Hazardous Waste Management and Community Participation Augmented with EIA Analysis:

Legal Aspects of Solid and Hazardous Waste Management in India and comparing it with other countries, Community Participation to raise the public awareness in a locality, Institutional aspects and Capacity Building, Prospects of Private Sector Participation, EIA process for Solid and Hazardous Waste Management aided with a Management Information System.

Text Books:

1. Integrated solid waste management. Tchobanoglous, Theissen and Vigil-McGraw Hill Book Co. 2. Solid waste management in developing courtiers, B B Sundersen and A D Bhide, Indian National Scientific Documentations Centre, New Delhi.
Reference Books:
1 Hazardous waste management LaGrega, Buckingham & Evans. McGraw Hill Book Co. 2. Solid wastes - Engineering principles and management issues. Tchobanoglous, Theissenand Eliassen. McGraw Hill Book Co. 3 CPHEEO Manual on Solid Waste Management, Urban Development Authority

Geology for Engineers (Open Elective Course - III)					
COURSE OUTLINE					
Course Title:	Geology for Engineers	**Short Title:**	*GE*	**Course Code:**	
Course description:					
Geology is a basic subject for engineers especially for design of mega size structures, may be multistoried buildings, dams, tunnels bridges etc. Students of civil engineering have a basic course in geology as a lab work at second year level. Students interested for detailed study of the subject may opt for this subject. This course is designed to enable students to evaluate, to apply and to analyze the relevant geological principles. In this course, the related topics on rock types/classifications, geological structures and geological processes are covered. The principles of Structural geology are introduced mainly to highlight the relevancy of engineering properties of geological materials in designing rock engineering projects. At the end of the course, students acquainted with related knowledge and principles in geology and can be able to apply these knowledge and principles in designing safe and economic engineering structures in rock masses.					

Lecture	Hours/week	No. of weeks		Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):
NIL
Course objectives:

1. The prime objective of this course is to enable a student to identify the role of geologist in civil engineering projects.
2. It will enable students to understand the characteristics of ground water and its flow, to investigate the geological aspect of earthquakes and other engineering problems.
3. It assists student to demonstrate the concept and principles involved in geological exploration for engineering projects.
4. It will also enable students to examine the role of geological factors on mega engineering structures like tunnels, Dams, sky scrapers and bridges etc.

Course outcomes:

After successful completion of this course the student will be able to:

1. To identify rocks and minerals.
2. To interpret geological maps and deal with features like ground water structural features, prevailing under area of considerations.
3. To evaluate the geological factors with respect to good building material, morphological condition.
4. Plan the geological exploration or investigation, depending on extent of importance of civil engineering structures.
5. Predict the geological reason for performance of civil engineering structures like dam, tunnel etc.

COURSE CONTENT

Geology for Engineers		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3hours/week**	**End semester exam (ESE):**	**60**
		Duration of ESE:	**03**
		Internal Sessional Exams (ISE):	**40**

Unit–I:	**No. of Lectures: 09Hours**	**12**

Introduction: Objectives, scope, rock forming minerals, primary and secondary minerals. Silicate and non silicate minerals, felsic and mafic minerals, essentials and accessories minerals. Origin, texture, structure, classification of igneous rocks, secondary rocks, metamorphic rocks and their engineering applications Foundation of cities.		
Unit–II:	**No. of Lectures: 09Hours**	**12**
Structural Geology, Plate Tectonics & Ground water Structural geology: Outcrop, dip and strike, conformable series, unconformity and overlap. Inliers and outliers. Faults and their types, folds and their types, Structural features resulted due to igneous intrusions, concordant and discordant igneous intrusions. Joints and their types and Introduction to plate tectonics. Water table and depth zones, relation between surface relief and water table, perched water table. Natural springs and seepages, contact springs, hot springs and geysers, artesian wells.		
Unit–III:	**No. of Lectures: 08 Hours**	**12**

Geomorphology, Historical Geology & Building stones

Geomorphology: geological action of river, rejuvenation, land forms resulted due to river erosion, deposition and rejuvenation.

Physiographic divisions of India and their characteristics, geological history of peninsula, study of formations in peninsula and the significance of their structural characters in major civil engineering activities. Field characters of Deccan Trap basalt

Requirements of good building stones, engineering properties of rocks. Availability of blocks of suitable size and appearance on mineral composition, textures, structures.

Earthquake & its causes, classification, seismic zones of India & geological consideration for constructions of building.

Geology of soil formation, suitability of Deccan trap basalt as construction material.

Unit–IV:	**No. of Lectures: 08Hours**	**12**

Preliminary Geological Studies, Remote Sensing, Geo physical exploration.

Verification of surface data by subsurface exploration, drill holes, test pits, trenches, exploratory tunnels, shafts, audits, drifts, etc.

Compilation and interpretation of information obtained from these. Correlation of surface data with results of subsurface exploration.

Limitations of drilling, comparative reliability of data obtained by drilling and excavation.

Engineering significance of geological structures such as stratification, dips, folds, faults, joints, crush zones, fault zones, dykes etc.

Landslides and its causes, preventive measures and case studies.

Principles of geo physical exploration, Gravitational, electric, magnetic seismic methods for sub surface survey.

Unit–V:	**No. of Lectures: 08Hours**	**12**

Role of Engineering Geology in Dams and tunneling Preliminary geological investigation for tunnels. important geological consideration while choosing alignment Role of groundwater, geological conditions likely to be troublesome, suitability of common rock type for tunneling, unlined tunnels, case studies. a) Geological requirements for construction of dams and geological structures influence of geological condition on the choice of type and design of dam. b) Preliminary geological work on dam sites, favorable and unsuitable geological conditions for locating a dam, precaution to be taken to counteract unsuitable condition c) Treatment of leaky rocks, faults, dykes, crush zones, joints, fractures, unfavorable dips, etc. and case studies. d) Tail channel erosion , importance , case study
Text Books:
1. K V G K Gokhale : Text Book of Engineering Geology, B S Publication 2. P. K. Mukerjee : A text Book of Geology, Calcutta Word Publishers. 3. Blyth F.G.M. A Geology for Engineers, Arnold London. 4. Prabin Singh. Engg. And general Geology. Katson Publishing House. 5. D. S. Arrora: Geology for Engineers, Mohindra Capital Publishing Candigarh.
Reference Books:

1. R.B. Gupte : A Text Book of Engineering Geology -P.V.G. Publications, Pune.
2. M. Anji Reddy : A Text Book of Remote Sensing and Geographical Information Systems by - 2nd Edition B S Publication.
3. R. Legget: Geology and Engineering - McGraw Hill Book Co., London.
4 Arthur Holmes : Physical Geology -ELBS Publication.
5 Tony Waltham : Fundamentals of Engineering Geology, SPON Press.
6 J.M. Treteth : Geology of Engineers, Princeton, Von. Nostrand.
7. F G Bell : Fundamentals of Engineering Geology, B S Publication

Environmental Impact Assessment (Open Elective Course - III)

COURSE OUTLINE

Course Title:	**Environmental Impact Assessment**	**Short Title:**	*EIA*	**Course Code:**	

Course description:

This course introduces the importance, scope and methodology of environmental impact assessment (EIA). EIA is a vital tool for sound environmental management and decision making regarding implementation of an engineering project. The course provides an overview of the concepts methods issues and various forms and stages of the EIA process.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

Environmental impact assessment (EIA) enables a student in anticipation and minimization of development's negative effects undertaken in the early stages of project planning and design, EIA helps shape development in a manner that best suits the local environmental and is most responsive to human needs.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the major principals of environmental impact assessment in India.
2. Understand the different steps within environmental impact assessment.
3. Communicate both orally and in written form the key aspects of environmental impact assessment.
4. Be able to access different case studies / examples of EIA in practice.

5. Discuss the implications of current jurisdictional and institutional arrangement in relation to EIA.

COURSE CONTENT

Environmental Impact Assessment		**Semester:**	
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Development and environment: Need of environmental impact assessment, concept of EIA, elements of EIA, environmental attributes, nature of impacts- primary, secondary, tertiary, short term and long term, local and regional, reversible and irreversible impacts.

Overview of impacts- Directly and indirectly measurable impacts with respect to air, noise, water, land, biological and socio economic environment.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Screening and scooping in EIA: terms of reference for conducting EIA, methodologies of EIA-check list, matrices, overlays, cost benefit analysis adaptive environment and management network.

Frame work of EIA: Scope of EIA, base line data collection, prediction of impacts, evaluation of impacts, Battelle environmental evaluation system, environmental management plan, green belt development, environmental quality monitoring, budgetary provisions for implementing control measures.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Environmental appraisal of project, MOEF questionnaire for environmental clearance, elements of public participation and hearing, case study on EIA of industrial, mining, highway and water resources projects, critical environmental issues and formulation of strategies for EMP for this project.

Environmental legislation- Basic concepts, critical issues, civil liabilities, various enactments and their provisions- water act (1974, 1978), forest conservation act (1980), air pollution control act (1981, 1988), water (cess) act 1977, environmental protection act 1986, public liability and insurance act.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Environmental audit- definition, concept of EA, types of environmental audits, benefits of EA, scope and objectives, environmental statement, procedural aspects of conducting EA pre-audit phase, onsite audit phase and post audit phase, water audit, energy audit, raw material audit and health & safety audit. Conservation of energy and water, waste minimization, economic benefits of EA.

Sustainable development and environmental management: concept of carrying capacity, assimilative and supportive capacity, carrying capacity based developmental planning process, regional EIA and preparation of regional EMP,

Development of action plan for critical environmental areas, training needs in EM and Environmental Educational Programs. Environmental management in India.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Resource management: types of resources, terrestrial (soil) resource, mineral plants and animal (biotic) resources, marine fresh water, air and bio energy resources, resource utilization, renewable and non-renewable resources. Optimal use of resources. Depletion of resources, causes and effects.

Human resources: importance of socio economic studies in development projects

Text Books:

1. Environmental Impact Assessment by R R Barthwal, New Age Publications Ltd.
2. Environmental Impact Assessment by L W Canter, McGraw-Hill Science publication.

Reference Books:
1. Environmental Impact Assessment, S.R. Khandeshwar N.S. Raman, A.R. Gajbhiye, Dreamtech Press. 2. Environmental Impact Assessment: Theory and Practice, Reddy, B S Publications.

Hydrology & Water Resources Engineering Lab

LAB COURSE OUTLINE

Course Title:	**Hydrology & Water Resources Engineering Lab**	**Short Title:**	*H&WREL*	**Course Code:**	

Course description:

Since the ancient times, water had been crucial parameter for development of civilization. Therefore Hydrology & Water Resources Engineering is included as a theory paper in the curriculum of the civil engineering. In addition to the theoretical knowledge, the students need practical exposure also. A student is supposed to practice a lot on analytical and design problems pertaining to hydrology and water resources development. The present course takes care of this aspect. It also includes visit to sites and study of videos for better understanding of curriculum.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	*14*	*28*	*01*

End Semester Exam (ESE) Pattern: ***Oral (OR)***

Prerequisite course(s):

Nil

Course objectives:

i. The basic objective of the present syllabus is to provide an opportunity to the student to practice on numerical problems of analysis and design related to hydrology and water resources engineering.
ii. It also provides a real world exposure to the students by including site visit in the curriculum.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Solve analytical problems pertaining to hydrology, unit hydrographs and mass flow curves.
2. Asses run of a catchment area, given the topographic characteristics and rainfall data.
3. Design a complete crop and water management plan of a region.
4. Design simple gravity dams.
5. Design diversion works.

LAB COURSE CONTENT

Hydrology & Water Resources Engineering Lab		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

LIST OF PRACTICAL (Assignments):

- Development of flood hydrograph from unit hydrograph and complex storm.
- Determination of reservoir capacity from mass inflow and mass demand curve.
- Stability analysis of a gravity dam considering all major forces.
- Stability analysis of slope of earth dam.
- Design of Ogee spillway with energy dissipator.
- Analysis of weir on permeable foundation by using Khosla's charts.
- Design of unlined canal in alluvium by using Garret's diagram /Lacey's equations (at
- least three sections along the alignment including calculation of design discharge from
- Command area and kor depth and kor period) and plotting L-section; also preparing
- Schedule of area statistics and channel dimensions.
- Detailed report along with drawings, based on visit to any dam; including proof of the

- Benefit - cost analysis of a water resources engineering project.

The students should visit to a dam site and reservoir.

Text Books:

1. Varshney R.S., Gupta S.C., Gupta R.L. Theory and Design of Irrigation Structures, Volume I and II", Fourth edition. New Chand & Bros., Roorki.
2. Bharat Singh - Irrigation Engineering.
3. Sharma R.K., "A Text Book of Hydrology & Water Resources", Dhanpat Rai and Sons.
4. K.B.Khushlani - Irrigation Engineering.

Reference Books:

1. Modi P.N. Irrigation, Water Resources and Water Power Engineering, Standard Book House, Delhi.
2. Garg S.K. Irigation Engineering And Hydraulic Structures. Khanna Publishers, Delhi.
3. Punmia B.C., Pande B.B., .Lal, 1999. Dams II: Irrigation and Water Power Engineering". Laxmi Publications Pvt. Ltd., New Delhi.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student's performance throughout the semester and term work prepared by the students in the form of journal.

Guidelines for ESE:

ESE shall be based on term work prepared by students & Evaluation will be based on performance during oral examination.

<table>
<tr><td colspan="6">Construction Engineering & Management Lab</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Construction Engineering & Management Lab</td><td>Short Title:</td><td>CEML</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:
Construction industry is gradually giving up the conventional and is adopting new paradigms. Digitalization, automation and computerization have revolutionized the construction industry. IoT is another new player in this sector. The present course has been designed to provide student with a practical, in-depth introduction and orientation of various construction methodology and management techniques used in the professional construction approach.</td></tr>
<tr><td colspan="6"></td></tr>
</table>

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	01	14	14	2
Laboratory	*02*	*14*	*28*	

Prerequisite course(s):

Nil

Course objectives:

1. To make student capable to handle variety of construction projects after completion of course.
2. The student must become aware of the new concepts coming up in the construction industry and must be updated with the use of latest technology.
3. The student must be able to give a quality output while strictly adhering to the time schedule.

Course outcomes:

After successful completion of this course the student will be able to:

1. An idea of how mega construction projects are dealt with.
2. An understanding of modern construction practices.
3. A good idea of basic construction dynamics – various stake holders, project objectives, resources required & project economics
4. A basic ability to plan, control & monitor construction projects with respect to time cost
5. An idea of how to optimize construction projects based on costs

LAB COURSE CONTENT

Construction Engineering & Management Lab		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Theory:	**1 hours/week**	**End semester exam (ESE):**	**25**
Practical:	**2 hours/week**	**Internal Sessional Exams (ICA:**	**25**

1. **Basic Construction**: Unique features of construction, construction projects: types & features, Phases of project, various agencies involved & their methods of execution.

   Construction project Planning :

   i. Stages of project planning : pre tender planning, pre-construction planning, detailed construction planning
   ii. Process of development of plans & Schedules, work break down structure, activity list, assessment of work content, estimating durations, sequence of activities
   iii. Technique of Planning : bar charts, Gantt charts
   iv. Networks : basic terminology, preparation of CPM network, computation of float values, critical & semi critical path
   v. PERT : Assumptions, PERT Analysis, determine their time estimate, calculating of probality completion

2. Construction methods :

i. Basic of form work and it staging for foundation, column beam and slab
ii. Common building construction methods (Conventional walls & slabs)
iii. Slip forms ; For tall structure
iv. Basic construction methods for steel structures
v. Basics construction methods for bridge

- Construction Equipment basics :
  i. Equipment for excavation, earthmoving, dewatering etc…
  ii. Concrete mixing, transporting & placing
  iii. Cranes, hoists etc..
  iv. Equipment for transportation of materials

3. Planning & organizing construction site & resources :

i. Site job layout – structures & other infrastructure
ii. Site organization, documentation, manpower, planning , organizing, staffing
iii. Materials ; concepts of planning, procurement and inventory control
iv. Equipment : basic planning & organizing
v. Funds ; sources of fund, cash flow

4. Project Monitoring & Control :

i. Supervision , record keeping, periodic progress reports, updating of plans, frequency & method of updating
ii. Common causes of time & cost over turns & corrective measures
iii. Quality control : concept of quality, quality of constructed structure, use of manuals & check list; ISO 9000 , ISO 14000 Only concept
iv. Safety on project site for various works, site accidents, their causes, preventive measures.
v. Audit of safety, accident report writing (as per CPWD/PWD format)

5. Contract management :

i. Importance of contracts, types of contracts, parties to a contract, common contract clauses

ii. Delays penalties and liquidated damages, force majeure
iii. Suspension & termination, changes and variation
iv. Dispute resolution methods , arbitration
v. Conciliation, essential of Conciliation.

Following activities are to be performed. Term works shall consist of journal giving details of the activities performed and assignment question answers.

b. Develop a bar chart for construction of G+2 or G +7 storied building with all activities (assuming reasonable activity durations)
c. Develop a bar chart for concerting 1500 sqm of a 15 cm thk slab using various equipment for production to placing of concrete at 3m height above GL
d. Develop a CPM chart for a 5 span bridge on open foundation
e. Write descriptive answer assignments questions from above contents**.**

Text Books:

- Varghese P C , Building construction, Prentice Hall India
- National Building Code, BIS, New Delhi
- Chudley R. Construction Technology , ELBS publishers
- Punmia B C, Project Planning with PERT & CPM, Laxmi publications
- Gopalan M.R. Project Management, WILLEY PUB.

Reference Books:

- Doald Barrie, Professional Construction Management,McGraw Hill Education.
- Saurabh Soni, Construction Management & Equipment, KATSON books Publishers
- Charles Patrick, Construction Project Planning &Scheduling,PEARSON
- JhakumarNeeraj, Construction Project management, Pearson Education India

<table>
<tr><td colspan="6">Major Project (Stage – I)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Major Project (Stage – I)</td><td>Short Title:</td><td>MPROJ-SI</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Laboratory work or experimentation is a line of distinction between science and other subjects. A project is an integration of experimental work performed to achieve an specific task. Projects not only teach experimentation, they teach resource planning and management, time and manpower management and ability work in team also. It also aims to enable to apply the theoretical concepts to solve problems with multidisciplinary approach. Ultimately it enables to demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.
Hence projects are given due space in the curriculum right from third year level.
The Major project stage I is the second link in the series. The objective of this project is primarily to formulate or identify a ‘problem’ that can be solved in the specified time and resources available and to actually solve it. The word problem is used in broad sense referring to any activity like analyzing, designing, fabricating, developing, surveying, etc.</td></tr>
<tr><td rowspan="2">Laboratory</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>6</td><td>14</td><td>84</td><td colspan="2">3</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="3">----</td></tr>
<tr><td colspan="6">Prerequisite course(s):</td></tr>
<tr><td colspan="6">Nil</td></tr>
<tr><td colspan="6">Course objectives:</td></tr>
<tr><td colspan="6">1. To understand the meaning, objectives and purpose of a practical size civil engineering project.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and</td></tr>
</table>

relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Undertake problem identification, formulation and solution
2. Demonstrate a sound technical knowledge of their selected project topic.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Demonstrate the knowledge, skills and attitudes of a professional engineer for problem solving.
5. Demonstrate ability to work in team

LAB COURSE CONTENT

Major Project (Stage – I)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**Internal Continuous Assessment (ICA):**	**50 marks**

At final year the students shall carry out a major project in a group of maximum five students. The project work spans both the semesters. By the end of Semester – VII the students shall complete the partial work, and by the end of Semester – VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of major projects.

The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design.

Majorr Project (Stage – I) Report will include literature survey, problem identification, work methodology, preparing material specification and material procurement, collection of data etc. Approximately 60% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester – VIII.

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The final assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Major Project (stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design/work done	Report writing	Depth of Understanding	Presentation	Total
	Marks	5	5	5	15	5	10	5	50

Essence of Indian Traditional Knowledge

Course objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:

Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:

Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.

5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher.
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan.
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.
11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Fourth Year Engineering

(Civil Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester - VIII

W.E.F. 2020 – 2021

Engineering Economy, Estimation & Costing					
COURSE OUTLINE					
Course Title:	*Engineering Economy, Estimating & Costing*	**Short Title:**	*EEEC*	**Course Code:**	

Course description:

Civil Engineering projects are mega projects involving huge cost, man power and time investment. A prediction of these requirements prior to the actual construction is necessary to take decision. The present work includes this aspect. It also includes the material and rate analysis and valuation aspect. The course also contains introduction to basic principles of economics applicable to civil engineering projects.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	44	*5*

Prerequisite course(s):

Nil

Course objectives:

The prime objective of this syllabus is to enable students to predict the cost of a civil engineering structure like building, dam, road, canal, bridge etc, prior to its construction thus to help in planning as well as in final payments of the bills. It also aims to enable student to evaluate the cost of an existing structure.

1. To enable student with working out quantities of various items involved in construction of structures
2. Student will also be able to work out the rate analysis
3. Student will also be able to work out the valuation of properties.

Course outcomes:

After successful completion of this course the student:

1. Will attain the level of proficiency to prepare approximate as well as detailed estimate

of civil engineering projects.

2. Is competent enough to calculate the amount of material, labours & machinery required to execute any civil construction projects
3. Is expected to understand the terminologies associated with valuation, trained to make bills of venders of civil construction works
4. Have an idea of economics in general viz public sector and private business
5. Be able to perform and evaluate present worth, future worth & annual worth analyses on one of more economic alternatives, be able to understand how competitive bidding works & how to submit a competitive bid proposal.

COURSE CONTENT

Engineering Economy, Estimation& Costing		**Semester: VIII**	
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Economics: Basics Principles &Methodology of economics. Demand & supply, Theory of firm & Market structure, Basic Macro-economic concepts (including GDP/GNP/NI/Disposal income) and adenitis for both closed and open economics. Price indices (WPI/CPI), Interest rates, direct & indirect taxes.

Elements of Business Economics, Forms of organizations. Cost & its control techniques. Types of cost, lifecycle costs, budgets, Breakeven Analysis, capital Budgeting.

Investment analysis- NPV, ROI, IRR, Payback Period, Depreciation, time value of money (present & future worth of cash flow. Business forecasting – elementary techniques

Commercial banks & their functions. Public sector Economics – welfare, externalities.

Indian Economy – brief overview, Employment – informal, organized, unorganized public, private sector.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Estimating: Approximate estimate for building, roads, bridges. Detailed estimate: types, purpose, data required for preparing detailed estimate, Measurements for various items, use of relevant Indian Standard Specifications for various items, taking out quantities from the given requirement of the work. Estimating Concrete stair case, RCC elements like slab, beam column footing & masonry, finishes, interiors. Estimate of load bearing residential building, framed structure residential building.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Bar bending schedules: for RCC Elements like slab, beam, column, footing, staircase & retaining wall.Prepartion of Bar Bending Schedule (BBS) for use of Bar bender on actual site work.Mass haul diagram, Estimating earthwork for road work, irrigation works. Material survey – thumb rules for computations of material requirement for different material for building, percentage breakup of the cost, market survey for basic material.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Rate Analysis : purpose, importance & necessity of the same, factor affecting, task work, daily output from different equipment, labour (skilled / unskilled), analysis of rates of items like excavation, RCC works, Masonry (brick/stone), Plastering work, building finishes work. Specifications : types – requirements and importance, detailed specification for building roads , bridge & industrial structure. For building works: RCC works , Brick masonry & Plastering .		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tender : preparation of tender documents, importance of inviting tenders, types of contracts, relative merits, prequalification. General & special Conditions : termination of contracts, extra works & changes, penalty and liquidated charges, settlements of disputes.		

RA Bill & Final Bill, payment of advance, insurance claims, price variation, etc. Preparing Bids: Bid price build up: material, labour, equipment cost, risks, direct indirect over heads, profit; bid conditions. Bid process management. Introduction to acts pertaining to minimum wages, Workman's compensation, contracts, Arbitrations.
Text Books:
1. *Dutta B N, Estimating & Costing in civil engineering UBS Publishers* 2. *Birde G. S., Text book of estimating & costing, Dhanpatrai publishing* 3. *Misra S. K. &Puri, Indian economy, Himalaya publishers* 4. *Pareeksaroj Text book of business Economics, Sunrise Publishers* 5. *V. mote, S. Paul, G Gupta, Managerial economics, Tata Mcgraw Hill*
Reference Books:
i. Mankiw Gregory N. Principles of Economics, Thompson Asia ii. Quantity Surveyor's Pocket Book, Duncan Cartilidge, BH Publications. iii. Joy P K, Handbook of Construction Management, Macmillan iv. District Schedule Rate (DSR).

<table>
<tr><td colspan="6">Advanced Concrete Structural Analysis and Design (Professional Elective Course - V)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Advanced Concrete Structural Analysis and Design</td><td>Short Title:</td><td>ACSA&D</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Design of structures is considered traditionally to be the primary job of civil engineers. Concrete is the most common material is used for construction presently. Hence design of concrete structures is an integral part of civil engineering syllabus. One basic course in this is already there at third year level. However students interested for the design of special structures like domes, combined footings, retaining walls, water tanks, flat slabs prestressed concrete structures, etc may opt this subject. The syllabus confirms to the relevant IS codes.</td></tr>
</table>

<table>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester credits</td></tr>
<tr><td>03</td><td>14</td><td>40</td><td>04</td></tr>
<tr><td colspan="5">Prerequisite course(s):</td></tr>
<tr><td colspan="5">Nil</td></tr>
<tr><td colspan="5">Course objectives:</td></tr>
<tr><td colspan="5">1. The main objective is to enable a student with the analysis and design of RCC special structures, including chimneys, water tanks, domes, flat slabs etc.
2. The students should be appraised with prestressed concrete material, which is a relatively newer concept.
3. The students should be illustrated with the techniques of selection of type of structure for a particular requirement, assessment of loads coming on it, load combinations, design of structure considering architectural as well as safety and economic aspects, confirming to relevant codes of practices.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Course outcomes:</td></tr>
<tr><td colspan="5">After successful completion of this course the student will be able to:</td></tr>
</table>

1. Demonstrate ability to assess critical loads and its combinations for special RCC structures like flat slabs and combined footing and analyze and design them.
2. Demonstrate ability to assess critical loads and its combinations for special RCC structures like Cantilever Retaining wall and dome and to analyze and design them.
3. Demonstrate ability to analyze and design water tanks.
4. Understand basic concepts and principles of pre-stressing and methods used for it.
5. Demonstrate ability to analyze and design pre-stressed concrete beam.

COURSE CONTENT

		Semester:	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Flat Slab

Introduction, Terminology Related With Flat Slab, IS Code Provisions for Flat Slab Construction, Analysis of Flat Slab, **The Direct Design Method,** Distribution of Bending Moment Across the Panel Width, Shear in Flat Slab, Equivalent Frame Method, Reinforcement Detailing in a Flat Slab. Analysis, design and reinforcement detailing of interior panel of flat slab.

Combined Footing:

Introduction –necessity, types, analysis and design of rectangular combined footing as per IS code, reinforcement detailing,

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Retaining Walls

Introduction, Types of Retaining Walls, Earth Pressure on Retaining Walls, Forces on a Cantilever Retaining Wall, Stability of a Cantilever Retaining Wall, Proportioning of the Cantilever Retaining Wall, Structural Behaviour and Design of a Cantilever Retaining Wall.

Analysis and design of cantilever level backfill retaining wall. Analysis, design and reinforcement detailing of thin dome without crown load with small angle at crown.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design of Water Tank Introduction, Design Philosophy and Requirements, IS Code Recommendations Regarding Detailing in Water Tanks, Joints in Water Tanks, Jointing Materials. Analysis of Circular tanks Resting on the Ground, Tank With Flexible Joint Between the Floor and the Walls (Approximate Method), Circular Tank width Rigid Joint Between Floor and the Wall (Approximate Method), IS Code Method for Design of Circular Tanks. Analysis, design and reinforcement detailing of Rectangular Water Tanks resting on the ground using approximate method of designing. Analysis, design and reinforcement detailing of Rectangular underground Water Tanks with condition i) Tank is Empty and Active Earth Pressure is Present, ii) Tank is Full and there is no Earth Fill.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
1.General principles of prestressed concrete members: Introduction- definition-need of prestressing-use of high strength concrete-use of high tensile steel-assumptions-stress concept-beam with concentric tendon-effect of loading on the stress in the tendons- beam with eccentric tendons-effect of loading on the stress in the tendons-beam with bent tendon- beams of rectangular, T and I sections-the pressure line – C – line and P – line –strength concept – review of different techniques. **2.System of prestressing**: Classification of prestressed concrete members – externally and internally prestressed members- linear prestressing pretensioning post-tensioning- bonded and unbonded tendons-the Hoyer system – the Freyssinet system- The magnel blaton system-The Gifford Udall system-C.C.L. standard system-The Lee – Mccall system.		

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

1.Loss in prestress:

Losses of prestress at various stages – loss of stress due to length and curvature effects – loss of stress at the anchoring stage – loss of stress due to shrinkage of concrete- loss of stress due to creep of concrete – loss of stress due to elastic shortening of concrete – loss of stress due to creep in steel.

2.Design of Prestressed concrete beams:

Simply supported beams – design principles- I.S. Recommendations - permissible stresses – various stages of analysis – lever arm conception – P and C lines – kern distance – Rectangular and I sections.

Text Books:

1. Reinforced Cement Concrete Design by Neelam Sharma, S. K. Kataria & Sons.
2. Reinforced Concrete Design by S Unnikrishna Pillai and Devdas Menon Tata McGraw-Hill
3. Prestressed Concrete by S. Ramamrutham, Dhanpat Rai Publishing Company
4. Prestressed Concrete by N. Rajagopalan, Narosa Publishing House.
5. Design of Reinforced Concrete Structures by S. Ramamrutham, Dhanpat Rai Publishing Company.
6. Design Of Reinforced Concrete Structures, by Subramanian N, Oxford University Press.

Reference Books:

1. Prestressed Concrete by N. Krishna Raju, The McGraw Hill Companies.
2. Limit state design of reinforced concrete by B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publication.
3. Design of Prestresssd Concrete Structures by T. Y. Lin and Ned H. Burns, Willey Publisher.
4. Analysis and Design of Prestressed Concrete Structures by Dr. Hussam, available on https://www.researchgate.net/publication/328202827_Analysis_and_Design_of_Prestressed_Concrete_Structures**.**

Hydraulic Machines (Professional Elective Course - V)

COURSE OUTLINE

Course Title:	Hydraulic Machines	**Short Title:**	*HM*	**Course Code:**	

Course description:

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Nil

Course objectives:

The present course will fulfill following objectives:

1. To enable student to Classify Hydraulic Machines.
2. To enable student to understand the Principle and Working of various Hydraulic Machines.
3. To enable students to analyze the performance of Various Hydraulic Machines.
4. To enable students to design the Various elements of Hydel Power Plant.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze and evaluate the performance of hydraulic turbines
2. Analyze and evaluate the performance of pumps
3. Design Hydraulic Machines employed in Hydel Power Plants
4. Design the overall Layout Hydel Power Plants.
5. To draw the Phasor diagram for various Hydraulic Machines

COURSE CONTENT					
Hydraulic Machinery			**Semester:**	VIII	
Teaching Scheme:			**Examination scheme**		
Lectures:	**3 hours/week**		**End semester exam (ESE):**		**60 marks**
			Duration of ESE:		**03 hours**
			Internal Sessional Exams (ISE):		**40 marks**
Unit–I:		**No. of Lectures: 09 Hours**		**Marks: 12**	

Principles of Fluid Machines

Introduction, Classification of common Fluid Machines, their uses in civil engineering practices.

The Linear-Momentum Equation – theory, derivation, application in fluid machinery, Impact of jet on fixed and moving Vanes - theory, derivations of formulae, applications to hydraulic machines, The Angular- Momentum Principle, Euler Equation for Turbo machines.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Hydraulic Turbines-I

Hydro Electric Power Plants: Components of Hydro Electric Power Plants, Classification of Hydel plants. Classification of hydraulic Turbines, Principle, theory and formulae for Design of Hydel Power Plants. Design problems.

Pelton Turbine: Components and their functions, Force, Power and Efficiency, Design of components, Specific speed, Limitations, principle, theory and formulae for Design of Pelton Turbine

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Hydraulic Turbines-II

Francis Turbine: Components, Draft tube. Design of components, Degree of reaction, specific speed and runner shapes, Types of draft tubes, Cavitations, Thoma's Cavitations parameter.

Kaplan/Propeller Turbine: Components, Design Parameters

Main and operating Characteristics of Turbines, Model Testing, Governing of turbines, surge

tanks, Selection of turbines, Bulb turbines, pumped storage power plants.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Pumps-I Classification of Pumps: Positive displacement & Non positive displacement pumps, Positive Displacement Pumps: Types and applications. Reciprocating Pumps: Components, Working, Types, Work done by reciprocating pump, Indicator Diagram, Effects of acceleration of piston, Air vessels. Rotary Pumps: Gear pumps, vane pumps & Piston pumps, Classification, Construction and Working aspects, Characteristics.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Pumps-II Centrifugal Pumps: Introduction, classification of pumps, Pumping System and the Net Head Developed, Centrifugal pump components and their functions. Mechanical seals, Materials of construction, Slip Factor, Terminology frequently used theory of centrifugal pump impeller: Euler‟ Head, Theoretical characteristics, Losses and Efficiencies. pump characteristics, Duty point, Pumping systems and system head curves, Operating point, Specific speed and its relation with pump characteristics, model testing, Pumps in Series and Parallel NPSH & Cavitation in Pumps: Calculation of NPSH (A) and significance. Axial Flow or Propeller Pump. Selection of pumps, Axial Thrust & Radial Thrust, Operation and Maintenance of pumps, Field Troubles Pump testing: procedure for testing, tolerances allowed (reference to IS codes), Affinity laws.		
Text Books:		
1. S. K. Som, G. Biswas, Suman Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Education. 2. Dr P. N. Modi & Dr. S. M. Seth, Hydraulics and Fluid Mechanics including Hydraulic Machines,		

Standard Book House. 3. Bansal, R. K., A textbook of fluid mechanics and hydraulic machines, Laxmi Publications.
Reference Books:
1. Miroslav Nechleba, Hydraulic Turbines, ARTIA Prague 2. J. Stepanoff, Centrifugal and Axial flow Pumps, John Wiley & Sons, Inc. 3. S. M. Yahya, Turbines Compressors and Fans, Tata McGraw – Hill, Fourth Edition.

Advanced wastewater treatment technology (Professional Elective Course - V)

COURSE OUTLINE

Course Title:	*Advanced Wastewater Treatment Technology*	**Short Title:**	*AWTT*	**Course Code:**	

Course description:

Wastewater is the principal cause of surface and ground water pollution. This wastewater can be collected from various sources and treated to reduce its pollution strength to permissible level. Then it can be discharged into natural bodies or it can be recycled also. The present syllabus describes the importance, necessity, and technology for wastewater collection, characterization, treatment, disposal and feasible reuse. The course includes the conventional as well as latest technology available in the field of wastewater engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Nil

Course objectives:

The requisite objectives needs to be fulfilled are as follows:

1. To allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment
2. To Design the Various elements of waste water treatment Plant.
3. To aware about the various treatment methodologies for industrial waste.
4. To understand the Principle and Working of CETP.
5. To improve the awareness amongst the students related to the environmental scenario.

Course outcomes:

After successful completion of this course the student will be able to:

1. Effectively plan wastewater projects.
2. Appreciate unit operations and unit processes in wastewater treatment.

3. Demonstrate ability to work out appropriate flow sheet for specific wastewater treatment.
4. Design all unit of a wastewater treatment plant.
5. Develop treatment technology for special wastewater through lab studies and field trials.

COURSE CONTENT				
Advanced wastewater treatment technology		**Semester:**	*VII*	
Teaching Scheme:		**Examination scheme**		
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fluctuations in quality and quantity. Sampling, preservation of samples. C.O.D. B.O.D. Aerobic decomposition of organic material. Five day and ultimate values of oxygen demand. Population equivalent. Generalized B.O.D. formulations. Different methods of B.O.D. curve fitting. Various equations mathematical, Nitrogen and phosphorous. Objectives of sewage treatment, unit operations, Process design and hydraulic design. Period of design, Pre-treatment, primary treatment and secondary treatment methods Percentage removal and overall efficiency. Physics, chemical and biological methods of treatment. Measurement of sewage flow. Economics.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Screening, Design of fixed and rotary screens. Operation, disposal of screening, comminutors. Separation of grit. Principles of sedimentation applied to design of grit chambers. Primary, intermediate and final clarification. Intermittent or continuous removal of sludge. Scum removal. Factors affecting performance. Sedimentation aided by chemicals.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Principles of biological treatment of sewage, Mechanism of stabilization, zoological films. Design and operation of trickling filters, Rotating Biological Contactors, Biological treatment in activated sludge process: Loading parameters, Sludge Volume Index, Process control, Aeration requirements and methods of Aerations, Activated sludge process modification. Mathematical models and optimization, Aerated lagoons, Oxidation ditches Sequential Batch Reactor, Membrane Bio reactor, Moving Media Bio Reactor.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
General considerations in disposal of sludge, Sludge pumping. Quantities, Characteristics and behavior of sludge. Moisture–weight–volume relationships. Digestibility, Fuel value, Fertilizer value, Flow characteristics. Unit operations in sludge disposal, Design of sludge digestion tanks. Disposal of digested sludge, and supernatants. Gas utilization. Kinetics of sludge digestion. Design of thickeners. Disinfection of sewage effluents. Natural Treatment Systems: Stabilization Pond, Design considerations in oxidation of stabilization pond, Natural and Constructed Wetlands, Vermiculture, Wastewater Irrigation.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design consideration in septic tanks, Up-flow Anaerobic filters, Effluent disposal. Wastewater Reuse: Industry, Agriculture. advanced and non conventional wastewater treatment technology. Adsorption – kinetics, low cost sorbents, factors affecting sorption. Basics of photo catalysis. Hazardous waste treatment.		
Text Books		
1. Wastewater Engineering-Treatment, disposal, reuse Metcalf & Eddy 4th Edition 2003. Tata McGraw Hill International Editions. 2. Water and Wastewater Engineering-Vol. II Fair, Geyer & Okun Wiley Toppan Co. Ltd. 1981, Tokyo.		

3. CPHEEO Manual of sewerage and Sewage Treatment 1993. Ministry of Urban Development. 4. Wastewater Treatment for Pollution Control S. J. Arceivala Tata McGraw hill Publishing Co. Ltd. 3rd Edition, 2007, New Delhi.
Reference books
1. Wastewater treatment Plants Planning, Design and Operation. S.R. Qasium CBS International Edition. 2. Waste Water Engineering, R. Parker, N. Morris, F. N. Fair, S. C. Bhatia, CBS publishers & distributors, 2008, New Delhi.

<table>
<tr><td colspan="6">Foundation Engineering (Professional Elective Course - V)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Foundation Engineering</td><td>Short Title:</td><td>FE</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Foundation is the first and most important component of a building structure which transmits load to the soil beneath. The students of civil engineering already have a basic course in geotechnical engineering in which soil properties, behavior of soil under load are included. Students interested for in depth study of foundations will find the present course worthy. The course includes classification of foundations, their analysis, design etc. Topics of relevance like bearing capacity, Theories of lateral earth pressure, retaining wall etc are also included in the syllabus.</td></tr>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>3</td><td>14</td><td>42</td><td colspan="2">03</td></tr>
<tr><td colspan="6">Prerequisite course(s):</td></tr>
<tr><td colspan="6">Nil</td></tr>
<tr><td colspan="6">Course objectives:</td></tr>
<tr><td colspan="6">1) To enable a student to estimate of bearing capacity of shallow foundations by various theories.
2) To enable to design mat foundation and understand design consideration for foundations on difficult soils
3) To demonstrate the need for pile foundations and determine their load carrying capacity.
4) To demonstrate in brief theories of lateral earth pressure.
5) To enable to analyze and design Gravity, Cantilever Mechanically Stabilized Retaining walls</td></tr>
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</table>

Course outcomes:

After successful completion of this course the student will be able to:

1) To determine bearing capacity of shallow foundation and concept of consolidation settlement.
2) Design of mat foundation and foundations on foundations on difficult soils.
3) Design of pile foundation and to analyze pile foundation settlement
4) Understand theories and design considerations of Lateral earth pressure
5) Analyze and design Gravity, Cantilever Mechanically Stabilized Retaining wall

COURSE CONTENT

Foundation Engineering		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Shallow Foundations

Introduction, Tertzaghi's bearing capacity theory, Effect of water table, numerical problem, factor of safety, Effect of soil compressibility, Eccentrically loaded foundations, Ultimate Bearing capacity for one way and two way eccentricity. Bearing capacity of a continuous foundation subjected to eccentrically inclined loading. Numerical problems.

Consolidation settlement

Primary consolidation settlement relationships, Three dimensional effects on consolidation settlement, Field Load Test, Presumptive bearing capacity, Tolerable settlement of buildings. Problems.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mat Foundations:

Introduction, Combine footings, types of mat foundations, bearing capacity, differential settlement of mats, Field Settlement Observations for mat foundations. Compensated foundations. Structural design of mat foundations.

Foundations on Difficult soils:

Design of foundation Susceptible to wetting, collapsible soil, foundation considerations for expansive soil. Numerical problems

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Pile Foundations:

Types and their structural characteristics, Estimating pile length, Piles installation, Load transfer mechanism, Meyerhof's and Vesic's method for estimating pile capacity, ultimate capacity of group piles in saturated clay, elastic and consolidation settlement of group piles. Piles in rock. Numerical Problems.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Lateral Earth Pressure

Rankine's active and passive earth pressure, Generalized case for granular backfill, active and passive earth pressure with vertical wall back-face and inclined c'- ϕ' soil backfill, coulomb's active and passive earth pressure, earth pressure due to surcharge, active and passive earth pressure for earthquake conditions-granular backfill.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Gravity and Cantilever Retaining Walls

Proportioning, application of lateral earth pressure theories, stability check, check for overturning, check for sliding along the base, check for bearing capacity failure, construction joints and drainage from backfill. Problems

Mechanically Stabilized Retaining wall

Soil reinforcement, Design considerations, retaining wall design with metallic strip reinforcement, retaining wall with geotextile reinforcement, Retaining wall with geogrid reinforcement and design. Numerical Problems.

Text Books:

1) Kasmalkar B. J. “Geotechnical Engineering”, Pune Vidyarthi Griha Prakashana, Sadashiv Peth Pune-30, Latest edition.
2) V. N. S. Murthy “Soil mechanics and foundation engineering”,Vol.1, Saikrupa Technical Consultants, Bangalore, Latest edition.
3) Shashi K. Gulhati and Manoj Datta, “Geotechnical Engineering” Tata McGraw Hill Publication, Latest edition.

Reference Books:

1) Punmia B. C. “Soil mechanics and foundation engineering ” , Laxmi Publications Pvt. Ltd., New Delhi, Latest edition.
2) J.E.Bowles, “Foundation analysis and design”, McGraw Hill International. New York.
3) Wayne C. Teng, “Foundation Design” Prentice Hall of India, New Delhi.
4) K.R. Arora, “Soil Mechanics and Foundation Engineering” Standard Publishers Distributors.
5) T.W. Lambe, “Soil Testing for Engineers”, John Wiley Publication.
6) Gopal Ranjan, Rao, “Basic and Applied Soil Mechanics”, New age publication.
7) Braja M. Das, “Principles of foundation Engineering”, Cennage Publications, Delhi.

<table>
<tr><td colspan="6">Design of Hydraulic Structures (Professional Elective Course - VI)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Design of Hydraulic Structures</td><td>Short Title:</td><td>DHS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Hydraulic structures like different types of dams, canals, intake structures, water power generation structures etc are quite typical in their design due to continuous exposure to water and critical load combinations. They play important role in the socio economic development of a nation. They are generally mega projects and take large time for execution. They involve huge investment too. The present course includes basic descriptions of such structures, their design theories, analysis and complete design procedures. The design must be in accordance to the relevant IS specifications.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

<table>
<tr><td>Prerequisite course(s):</td></tr>
<tr><td>Nil</td></tr>
<tr><td>Course objectives:</td></tr>
<tr><td>The requisite objectives needs to be fulfilled are as follows:
1. To introduce the students with different types of dams, their modes of failures and stability analysis.
2. To introduce the students with the diversion head works and explain stability analysis of weirs on permeable foundation.
3. To explain the different type of spillway and their design principles.
4. To demonstrate the students with details of energy dissipation below spillway.
5. To demonstrate the unlined irrigation canals and their design principles.</td></tr>
<tr><td></td></tr>
<tr><td>Course outcomes:</td></tr>
<tr><td>After successful completion of this course the student will be able to:</td></tr>
</table>

1. Understand different type of dams, their suitability and their functions.
2. Demonstrate the design theory of different types of dams.
3. Demonstrate the diversion head works and its components.
4. Demonstrate and ability to analyze stability of weir on permeable foundation using Khosla's theory and analyze the energy dissipation below spillway
5. Design different sections of canals and their linings.

COURSE CONTENT

Design of Hydraulic Structures		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Dams:-Introduction and scope of the subject ,types of dams, reserviour storage zones, selection of site for dam ,choice of a dam ,economical height of dam.

Gravity dams:-Introduction ,cross section ,forces acting on dam, load combination as specified by IS 6512-1984, stresses in dam,modes of failures, stability analysis and design of gravity dam, elementary and practical profile, low and high dam ,materials of construction, control of cracking ,galleries ,joint and keys.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Spillway: Introduction, spillway capacity, different types of spillway, their construction and suitability,design principles of ogee spillway and sipon spillway.

Energy dissipation below spillway ,types of hydrallic jump height curves and tail water rating curves, various types of Energy Dissipaters.

Gates:-Various types of spillway crest gates and their uses.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Earth dams:- Introduction, types, element of earth dams basic design consideration ,causes og failures, piping its prevention, control of seepage ,drainage in earth dams, design of filter and racktoe, phreatic line, stability of U/S and D/S slopes under various situations, introduction to rockfill dam.

Diversion headworks: Introduction, selection of site types of weirs and barrage, layout of diversion headworks and its components and function, causes failures of weirs on parable foundation and remedies, design of subsurface flow ,safety against piping and uplift. Khosal'sa theory.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Canal irrigation: types of canals, canal alignment.

Design of unlined stable channels in alluvial. Kennedy's and Lacey's theory and their merits and demerits

Preliminary sediment transport theory, critical tractive in alluvial soil according to IS 7112-1973.

Lining of irrigation canals, advantage of lining, and economics of lining types of lining. Design of lined channel, land drainage, discharge and spacing of closed drain, various types of canal outlet.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Canal masonary work:- cross drainage works, necessity, types, selection, comparative merits and demits ,various types of falls, their necessity and location, distributary head regulator and cross regulator, escape canal .

River Training works:- Necessity and types of river training works and bank protection and their construction details. Hydropower:- General features of hydropower development .advantage of hydropower, types of hydropower plants and their layout ,assessments of power Potential .
Text Books:
1. S. K. Garg-Irrigation Engineering and Hydraulic Structures, Dhanpat Rai Publications. 2. Dr P. N. Modi & Dr. S. M. Seth, Hydraulics Water resources and water power engineering, Standard Book House. 3. Dr. BC Punmia, Irrigation and water Power engineering, Laxmi Publications.
Reference Books:
1. Engineering of Dams by William P. Creager, Read Book Publications. 2. Design of Hydraulic Structures, by DR R.P.RETHALIYA, Atul Prkashan

Bridge Engineering (Professional Elective Course - VI)

COURSE OUTLINE

Course Title:	Bridge Engineering	**Short Title:**	*BE*	**Course Code:**	

Course description:

Bridges are the most important and typical structures in civil engineering from architecture point of view as well as for structural engineering point of view. Bridges have history as old as the human civilization. The present syllabus includes classification of bridges, planning and design of different types of bridges, construction of bridges and maintenance of bridges. The design is in accordance to the most relevant IS codes for practice in bridge engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

The objectives of the present course are as follows:

1. To appraise a student from different types of bridges.
2. To enable a student to opt for an appropriate type of bridge for a specific case.
3. To enable a student to design an appropriate bridge architecturally.
4. To enable a student to design a bridge structurally
5. To carryout monitoring task of bridges, execute maintenance tasks.

Course outcomes:

After successful completion of this course the student will be able to:

1. Demonstrate an ability to opt an appropriate bridge type for a given case.
2. Demonstrate an ability to opt an appropriate bridge material for a given case.

3. Design a bridge considering traffic conditions, climatic conditions and economy.
4. Design bridge considering various load combinations.
5. Carryout maintenance and repair work of bridges.

COURSE CONTENT

Bridge Engineering		**Semester:**	***VIII***
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction

Introduction to bridge engineering, classification and components of bridges, layout, planning. Structural forms of bridge decks, beam and slab decks, cellular decks.

Loading Standards

Standard specification for bridges, IRC loadings for road bridges, loading standards for railway bridges.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Investigation for Bridges and culverts

Investigation for culverts and minor bridges, Topographic details, Catchment area map, Hydrologic particulars, Geotechnical details, Seismology of the area, navigational requirements, Construction resources, traffic forecast.

Design of culverts

Design of slab culvert, box culvert and skew bridge.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Superstructure design aspects

Material selection ,design principles, composite construction, Box girders, continuous girders, Permissible stresses in structural steel.

Superstructure design aspects

Structural classification of Rigid Frame bridge, site erection methods, analysis and design of steel girder bridges, cable stayed bridges, Introduction to Courbon's method, Henry-Jaegar method and Guyon - Massonet method. Design of T-beam PC bridges using Courbon's method.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Bearings

Definitions, Purpose of bearings, Fixed and Free Bearings, Materials for bearings, Maintenance of bearings, Classification and design of bearings. Expansion joints.

Substructure

Abutment, Piers, Wing wall, Setting out for piers and abutments, Materials used for Substructures, Forces acting on abutments and piers. Bridge inspection.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Foundation

Types of cassion, uses of cassions, material used for construction of well, cassions and pile foundation. classification of pile foundation. Advantages of pile, well and cassion foundation. Uses of Coffer dam.

Bridge foundations, design of open well, pile and caisson foundation. Analysis and design, types and design of wing walls.

Text Books:

1. Rangawala, "Bridge Engineering", Charotar Publication, Gujarat India

2. S.P. Bindra, " Principles and practice of bridge engineering" Dhanpatrai Publications

3. Aaheesh Kumar, " Bridge Engineering" Vayu Education of India

Reference Books:

1. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2. IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83
3. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House

Theory of Elasticity and Plasticity (Professional Elective Course - VI)								
COURSE OUTLINE								
Course Title:	Theory of Elasticity and Plasticity		**Short Title:**	*TEP*		**Course Code:**		
Course description:								
The materials used for civil engineering construction are traditionally considered as elastic. The behavior of a material under elastic conditions is a matter of interest for research engineers. However modern concept is to use the strength of material under plastic state also. Moreover, there are some extreme conditions under which material behaves plastic like e. g. Under extreme temperature to which a spaceship cell is subjected. Hence to explore the properties of an engineering material under elastic as well as plastic state is the requirement of modern design. This aspect is explored in the present course.								
Lecture	**Hours/week**		**No. of weeks**		**Total hours**		**Semester credits**	
	3		*14*		*42*		*03*	
Prerequisite course(s):								
Nil								
Course objectives:								
1. To appraise students about the changing paradigm of concrete technology. (Traditionally the civil engineering materials are explored for their performance under elastic conditions. However with the development of science and technology, the paradigm is changing. Modern materials are subjected to extreme condition under which they behave like plastic. 2. To demonstrate students about modern designs, the engineering properties of a material under elastic and plastic state are necessary to be explored. 3. The present syllabus introduces a student with the elastic and plastic properties of common engineering materials and prepares a student for research in these fields.								

Course outcomes:				
After successful completion of this course the student will be able to:				
4. Demonstrate an ability to describe Hooke's law, stress strain relationship, stress varients and stress transformation. 5. Describe and use Airy's function, equations of equilibrium and compatibility. 6. Demonstrate ability to describe relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations. 7. Aware of basic concepts of plasticity, yield criteria, Von Mises initial yield condition, the Tresca initial yield condition, strain hardening and rules of plastic flow. 8. Demonstrate ability to describe Plane stress and plane strain problems, torsion, bending of bars and tube under pressure.				
COURSE CONTENT				
Theory of Elasticity and Plasticity		**Semester:**	*VIII*	
Teaching Scheme:		**Examination scheme**		
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**	
Elasticity: Stress at a point, stress tensor, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions. Generalized Hook's law				
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**	
Plane stress, Plane strain and axisymmetric problems, Problems in 2D Cartesian coordinate system, Airy's stress function, bending of beams. Principal stresses and strains, Plane stress and Plane strain problems. Differential equations of equilibrium and compatibility equations.				

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Plasticity: Basic concepts, yield criteria, Criterion of yielding, von Mises initial yield condition, the Tresca initial yield condition, strain hardening rules of plastic flow different stress-strain relation, flowand deformation theories		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Plane stress and plane strain problems, torsion, bending of bars, theoretical problems. Examples of tube under pressure		
Text Books:		
1. Theory of Elasticity", Timoshenko and Goodier, McGraw hill book Co. 2. S. S. Bhavikatti – Structural Analysis-II Vikas Publishing House, Pvt Ltd 3. Sadhu Singh – Theory of Elasticity, Khanna Publishers		
Reference Books:		
1. "Applied Elasticity", Wang, McGraw hill book Co. 2. "Theory of Plasticity", J. Chakrabarti, McGraw hill book Co. 3. "Strength of Materials Vol – I & II", Timoshenko S., CBS Publishers 4. "Advanced Mechanics of Solids", Srinath L. S., Tata McGraw		

Industrial Wastewater Engineering (Professional Elective Course - VI)					
COURSE OUTLINE					
Course Title:	**Industrial Wastewater Engineering**	**Short Title:**	*IWE*	**Course Code:**	

Course description:

This course describes the importance, scope and technology used for industrial wastewater engineering. The syllabus includes design wastewater treatment facilities, commissioning, operation, maintenance, trouble shooting and augmentation, specially for industrial applications.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The basic objective of the course is to make aware a student about sources and characteristics of wastewaters from major industries.
2. Pollutional effects of major industries and their common treatment technologies.
3. The student should be able to curb the industrial wastewater pollution and thus to save the receiving water bodies.

Course outcomes:

After successful completion of this course the student will be able to:

1. A student will be able to understand the sources and amount of wastewater generated by major industries. .
2. A student will be able to assess the quality of wastewater generated by major industries.
3. A student will be able to design facilities for treatment of industrial wastewater.
4. A student will be able to commission and operated facilities for treatment of industrial wastewater.
5. A student will be aware about the prevailing environmental legislations and practices.

COURSE CONTENT

Industrial Wastewater Engineering		**Semester:**	
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Major industries in India and across globe, their process description, water uses, wastewater generation rates.

Sampling of wastewater, characteristics major industrial wastewaters, pollution effects, permissible standards, pollution control norms.

Special problems of Industrial wastewaters, segregation and mixing, balancing and equalization of industrial wastewaters.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Industrial waste treatment: treatment of dairy waste, eggs poultry and meat product industries, tanneries, distilleries, refineries, paper industry, textiles industry, sugar industry, paint industry, food processing industries, metal plating industries, steel plants, metallurgical industries, perto-chemcial industries, motor industries, acid plants, pesticide industries, fertilizer industries, chemical industries, pharmaceutical industries, leather industry, jute industry etc. Relevant IS codes. Typical problems of common industries in India with reference to wastewater treatment.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Legal aspects of industrial wastewater management, Regulatory agencies, Standards for treatment. Formation of pollution control boards and central and state levels, their functions, duties and responsibilities.

Concept of end of pipe and cleaner technology, Concept of water quality index and its application for industrial wastewater recirculation, concept of Reduce, Recover, Reuse, and Recycling. Concept of industrial ecology, integrated approach for industrial water and wastewater management. Housekeeping and its implications.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Combine effluent treatment plants, technological aspect of CETP, Effluent treatment plant manufacture in India, combined domestic and industrial wastewater treatment plants. Disposal of wastewaters in rivers and purification of industrial waste water.

Special wastewater treatment methods like adsorption, high pressure oxidation, Treatment with UV rays. Low cost sorbents. Kinetics of adsorption. Limitations of adsorption.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Acclimatization of bio mass for industrial wastewater treatment, principle, process, applications, case studies, limitations and future scope. Addition of nutrients in deficient wastewaters. Seeding of industrial wastewaters. Combined treatment of industrial wastewater with domestic wastewater.

photocatalysis: principle, materials used, factors affecting photo-catalysis, reactor configurations, design methodology for real world application. Sources of UV radiation.

Text Books:

1. Nemerow N.L., Liquid Wastes of Industry: Theory, Practices and Treatment, Addison Wesley Co. N.Y.
2. Industrial wastewater management by R Mahajan TMC publication

Reference Books:

1. Industrial water pollution control by W W Eekenfelder, McGraw-Hill Science/Engineering
2. Industrial waste treatment Manual by NEERI & CPHEEO.

Ground Improvement Technique (Professional Elective Course - VI)					
COURSE OUTLINE					
Course Title:	Ground Improvement Technique	**Short Title:**	GIT	**Course Code:**	

Course description:

The soil which provides support to any structure should have sufficient strength to transmit load safely without any failure. The availability of good soil is scared which make civil engineer to utilize available site for a given structure. The responsibility of a civil engineer is to make weak soil or problematic soil into a good soil. This requires understanding various ground improvement technique which can chosen based upon the characteristic of soil. It includes different compaction method, dewatering technique, various consolidation technique, grouting and use of geosynthetic.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The course enables students to introduce with the various types of improvement methods of engineering properties of soil.
2. The student will demonstrate the application of engineering methods to ground improvement projects.
3. S/he will have an ability to design suitable method depending upon type of soil, time requirement and economy.

Course outcomes:

After successful completion of this course the student will be able to:

1. To develop an awareness of problematic soils and selection of ground improvement

techniques based on soil conditions.

2. Understand basics of soil compaction.
3. To understand drainage, dewatering, grouting technique in ground improvement method.
4. To demonstrate an ability to describe the types and applications
5. To study the applications of geosynthetics to improve structural strength of soil.

COURSE CONTENT

Ground Improvement Technique		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Ground improvement - Role of ground improvement in foundation engineering – methods of ground improvement –geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Dewatering Techniques - Well points – Vacuum and electro-osmotic methods – Seepage analysis for two dimensional flow - fully and partially penetrated slots in homogeneous deposits (Simple cases only).

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

In-situ densification of cohesion-less soils and consolidation of cohesive soils: Dynamic compaction Vibroflotation, Sand compaction piles. Consolidation: Preloading with sand drains, and fabric drains, Stone columns - Lime pilesinstallation techniques only – relative merits and limitations – deep soil mixing

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Grouting - Types of grouts – Suspension grouts - solutions grouts - Grouting equipment and method - Grouting with soil, Bentonite - cement mixes and asphalt - Grout monitoring schemes.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Geosynthetics - Types – functions of Geotextiles – Separation – Filtration – Drainage - reinforcement - Geomembranes - Containments and barriers Application to Ground Anchors.		
Text Books:		
1. Ground Improvement Techniques by Purushothama Raj .P, Laxmi Publications (P) Ltd., New Delhi, 2000. 2. Soil Mechanics and Foundation Engineering by B C Punmia, Laxmi Publications. 3. Reinforced soil and its Engineering Applications – Swami Saran., I.K. International Pvt. Ltd.		
Reference Books:		
1. IS: 13094:1992- “Selection of ground improvement techniques for foundations in weak soils”. 2. Ground Improvement byMoseley .M.P, Blockie Academic and Professional, Chapman and Hall, Glassgow, 1998.		

<table>
<tr><td colspan="6">Operations Research Methods and Engineering Applications (Open Elective Course - IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Operations Research Methods & Engineering Application</td><td>Short Title:</td><td>ORMEA</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Decision making should neither be random nor be influenced by personal factors. This must be done rationally in a systematic manner so that under similar circumstances similar decisions are obtained. Such decisions will be beyond disputes and allegations. It is a very important task of engineering especially for project management. This course approach enables to student to develop the required skills and apply operations research techniques to all kinds of decision-making problems with special reference to civil engineering projects.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The student must be made aware about the need and importance of systematic decision making.
2. Student must be made aware about importance of research data interpretation and drawing conclusions out of it.
3. The students must know the techniques of operations research and must be able to apply them to solve real world problem.
4. Students must be prepared for handling managerial tasks using OR techniques and suggest solutions to managerial issues that arises time to time in organization.

Course outcomes:

After successful completion of this course the student will be able to:

1. Demonstrate ability phase out any project into activities and to construct network

diagrams of project. He/she must have knowledge about various forms & functional role of inventory

2. Define the problem, develop the model, solve the model using OR techniques.
3. Presents basic, assumption, limitations, components of any linear programming model & broad application areas of linear programming.
4. Able to understand steps of decision making process and to determine expected value of perfect information.
5. Demonstrate ability to formulate optimal strategies in conflict and competitive environment.

COURSE CONTENT

Operations Research Methods and Engineering Applications		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Operation Research :

- Quantities approach to decision making, history, definition, feature of OR,
- Advantages of model building, methodology & advantages of OR,
- Features of operations Research, Applications of operations Research
- Operations Research Models Practice

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Linear Programming :

- Introduction and structure of Linear Programming (LP)
- Assumption of an LP Model
- Advantages and limitations of Linear Programming

- Application areas of linear programming
- Guidelines on linear programming model formulation
- Linear Programming (LP) :
    i. By the Graphical Method
    ii. By the Simplex Method

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

- Decisions Theory & Decision Trees :
    i. Introduction and steps of decision making process
    ii. Types of decision making environments
    iii. Decision making under uncertainty
    iv. Decision making under risk
    v. Decision making with utilities & Tree Analysis
- Theory of Games :
    i. Two person zero sum games
    ii. Pure strategies (Minimax & Maximum Principles)
    iii. Mixed strategies games with saddle point
    iv. The Rules Of Dominance

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Project Management :

- Introduction of PERT and CPM
- Basic difference between PERT and CPM
- Phase of project management
- PERT /CPM network components & Precedence Relationship
    i. Rules for AOA Network construction
    ii. Errors & Dummies in Network
- Critical Path Analysis
    i. Forward pass Method

ii. Backward Pass Method
iii. Float (slack) of an activity and event
iv. To find the critical path

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

- Deterministic Inventory Control Models:
  i. Introduction & the meaning of inventory control
  ii. Functional role inventory control
  iii. Reasons for carrying inventory
  iv. Factors involved in inventory problem Analysis: inventory cost components, demand for inventory items, replenishment lead time
  v. Inventory building model: steps of inventory model building, replenishment. order size decisions & concept of EOQ, classification of EOQ.
  vi. Single item inventory control models without shortages.
- Probabilistic Inventory Control Model:
  i. Instantaneous Demand Inventory Control model without set up cost.
  ii. Continuous Demand Inventory Control model without set up cost Demand.

Text Books:

- J K SHARMA, Operations Research Theory & Applications, TRINITY Press
- Hamdy A Taha, Operations Research, Pearson
- Mittal Prakash M., Operations Research , Surendra Publications

Reference Books:

- Doald Barrie, Professional Construction Management, McGraw Hill Education.
- R. Panneeselram, Operations Research Theory & Applications, PHI
- Chary S.N. , Production & Operation Mangemnt, McGraw Hill.

<table>
<tr><td colspan="6" align="center">Biotechnology of Waste Treatment (Open Elective Course - IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Biotechnology of Waste Treatment</td><td>Short Title:</td><td>BWT</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Industrial and domestic wastewaters are the prime causes of water pollution. They can be treated prior to the discharge. The wastewaters containing organic impurities are treated by biological methods. This course is aimed to develop the basic knowledge of operations of wastewater treatment processes to undergraduate students. The goals of the course are to demonstrate the basic principles of biochemistry and microbiology involved in the treatment processes and their applications in engineering trade.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

<table>
<tr><td>Prerequisite course(s):</td></tr>
<tr><td>Nil</td></tr>
<tr><td>Course objectives:</td></tr>
<tr><td>1. The Objectives of course is to develop in students the basic knowledge of microbiology and chemistry involved in the wastewater treatment process for organically rich wastewaters.
2. The advanced wastewater treatment processes Including Nitrification, De-nitrification, activated sludge process, anaerobic digestion, photo-catalysis etc.</td></tr>
<tr><td></td></tr>
<tr><td>Course outcomes:</td></tr>
<tr><td>After successful completion of this course the student will be able to:</td></tr>
<tr><td>1. Select the best treatment alternative for a given wastewater.
2. Demonstrate the microbiology and biochemistry of the waste treatment process.</td></tr>
</table>

3. Apply basic knowledge in research and development related to biological process.
4. Demonstrate current applications of biotechnology and advances in the different areas i.e. environmental, bioremediation, bioleaching and xenobiotics etc.
5. Apply the theoretical concepts for designing the experiments for studying the metabolism of various compounds present in waste water.

COURSE CONTENT

Biotechnology of Waste Treatment		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction:

Concept and categories of Waste in pertinent to biological treatment, brief overview of domestic waste and Waste water Treatment, Site Selection surveys of a waste and wastewater treatment plant, Physical, Chemical and Biological Treatment Processes.

Microorganismsand their role in Waste Treatment:

Cell Structure, Eukaryotes, Prokaryotes, Viruses, their detection and quantification, Chemical composition of cell and nature of organic matter used by microorganisms, Metabolic classification of microorganisms: Phototrophs, Chemotrophs, application in environmental field, Nuisance causing organisms in Waste Treatment, Indicator Organisms in Waste Treatment Process.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Background of Biological Treatment of Waste:

Concept of Biological Treatment of Waste and Wastewater with an emphasis to Nitrification, De-nitrification, Aerobic, Anaerobic, Facultative, Suspended Growth, Attached Growth, C/N Ratio for Composting, Leachate from Landfills.

Metabolism and growth of Microorganisms in Waste Treatment: Central pathways, aerobic, anaerobic and fermentative metabolism of carbohydrates, proteins, lipids, nucleic acids and hydrocarbons, control of metabolic reactions, Nutrition and growth conditions: Temperature, pH, oxygen, nutritional requirements as selective agents for microbial population.Kinetics of biological growth, bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogenous metabolism, effect of temperature, application of growth and substrate removal kinetics to biological treatment, Enzymes function, classification, kinetics, inhibitors and inhibition.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Waste Characteristics: Characteristics of Waste with an emphasis to Biological Characteristics, Numerical Treatment on Characteristics of Waste, sampling protocol for waste collection, types of samples, number of samples to be collected for biological treatment. **Microbiology and ecology of the following Waste Treatment process:** Microbiology and ecology of activated sludge process, trickling filters, oxidation ponds, aerobic and anaerobic digesters, anaerobic filters, UASB reactors, composting, vermin composting and other methods.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design of Biological waste Treatment process with Numerical Treatment: Activated Sludge Process, Trickling Filter, Oxidation Ponds, Aerated Lagoons, Anaerobic Digesters, UASB Reactors, Rotating Biological Contactors, Composting Unit, Landfills, Incinerator and other methods. **Nitrification and De-nitrification Process in Waste water Treatment:** Introduction, Forms of nitrogen, Nitrifying and denitrifying bacteria, Stoichiometry of nitrification and de-nitrification, Process variables in nitrification and de-nitrification process, Nitrification processes: Plug flow v\s complete mix, Single stage v\s two stage systems, Bio-film nitrification, De-nitrification using methanol, Organic matter and thiosulfate and sulfide,		

Anaerobic reactor system, Numerical Treatment on the design of Nitrification and De-nitrification systems in the above Biological Treatment Process.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Hazardous Waste Management& Biological Control: Introduction - Xenobiotic compounds, recalcitrance, hazardous wastes - biodegradation of Xenobiotics , Biological detoxification, Biological control of foliar pathogens and pests with bacterial bio-control agents: bio-control agents, ecology of the plant pathogen or pest, source of antagonist, Empirical approaches to select bio-control agents. **Biological Degradation of Waste:** Introduction, Determination of biological degradability, Pilot studies: PCB (polychlorinated biphenols) biodegradation, Methylethyl ketone, Aerobic biodegradation: TCE (trichloro ethane) Degradation, Polycyclic aromatic hydrocarbon degradation, Oil degradation, phenanthrene degradation. **Bioremediation:** Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation, Solid phase bioremediation -land farming, prepared beds, soil piles, Phytoremediation, Composting, Bioventing &Biosparging; Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors.		
Text Books:		
1. Metcalf Eddy – Waste water Engineering – 3rd Ed., TMH publications. 2. Wastewater Treatment By SJ Arceiwala, ShyamAsolekar, TMH Publications. 3. Nicholas P. Cheremisinoff, Biotechnology for waste water treatment, Eastern Economy edition.		
Reference Books:		
1. P. F. Stanbury, A. Whitaker and S. J. Hall, Principles of fermentation technology Aditya book		

private limited.

2.. CPHEEO Manual on Water Supply, Urban Development Authority

3.. CPHEEO Manual on Wastewater, 1993, Urban Development Authority

<table>
<tr><td colspan="6">Internet of Things (Open Elective Course - IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Internet of Things</td><td>Short Title:</td><td>IoT</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course develops a foundation of concepts and solutions that supports the project planning & management concepts. Describe how to managing development of project by applying project management concepts. Project risk management provides students with an organized approach for managing the uncertainties that can lead to undesirable project outcomes. Course topics include: Project procurement management and post project analysis.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The objective of this course is to impart necessary and practical knowledge of components of Internet of Things.
2. To develop skills required to build real-life IoT based projects.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the design principles for connected devices
2. Understand the design principles of Internet connectivity
3. Analyze the concepts of knowledge acquiring, managing and storing
4. Understand the wide variety of sensors
5. Design the software for IoT applications

<table>
<tr><td colspan="6" align="center">COURSE CONTENT</td></tr>
<tr><td colspan="3">Internet of Things</td><td colspan="2">Semester:</td><td>VIII</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Lectures:</td><td colspan="2">3 hours/week</td><td colspan="2">End semester exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="3" rowspan="2"></td><td colspan="2">Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="2">Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
<tr><td colspan="2" align="center">Unit–I:</td><td colspan="2" align="center">No. of Lectures: 09 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Internet of Things: An Overview: Internet of Things, IoT Conceptual Framework , IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2" align="center">Unit–II:</td><td colspan="2" align="center">No. of Lectures: 09 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets Internet Connectivity Principles: Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS,
FTP, Telnet and Others</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2" align="center">Unit–III:</td><td colspan="2" align="center">No. of Lectures: 08 Hours</td><td colspan="2" align="center">Marks: 12</td></tr>
<tr><td colspan="6">Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes, Data Collection, Storage and Computing Using Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms</td></tr>
<tr><td colspan="6"></td></tr>
</table>

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology **Prototyping the Embedded Devices for IoT and M2M:** Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs **IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT		
Text Books:		
Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill		
Reference Books:		
Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi		

Interior Design (Open Elective Course IV)

COURSE OUTLINE

Course Title:	**Interior Design**	**Short Title:**	*ID*	**Course Code:**	

Course description:

Any building whether it is residential or commercial requires interior. Interior design is the art and science of enhancing the interior of a building to achieve a healthier and more aesthetically pleasing environment for the people using the space. This course enables a student to plan design and execute ainterior design project.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	*14*	*42*	*03*

Prerequisite course(s):

Nil

Course objectives:

1. The basic objective of this course is enabling a student to plan, design and execute interior design project.

2. The student must be able to understand various materials used and different planning concept of interior design.

3. The student must also be able to design and construct necessary structures for enhancing esthetics of the structure.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the functional planning of interior spaces.
2. Understand various elements and principle of interior design.
3. Demonstrate ability to design interior of building.
4. Understand the physical dimension of various furniture.
5. Understand construction of partition walls and false ceiling.

COURSE CONTENT

Interior Design		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**

		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**	
Interior Designs: Character of good design - Values of design, Influence of environment on design in tune with community & site location, Eco friendly designing, Creative problem solving, styles & taste **Functional Planning of Interior Spaces** - Planning for specific functions, Planning for coordination & circulation, Psychological space planning			
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**	
Elements of Interior Design: Form, texture, hard, medium, soft & importance of texture in design Light- Importance of light as an art element & effect of light color & texture. Space - Organization of space in design. Color- Importance of color as an art element Color theory- Lightness & Darkness, intensity, Brightness &, dullness warm & cool color, paint & their properties- how to apply, textures & patterns			
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Principles of Design: Balance its definition, types, formal & informal balance. Harmony definition, aspect of harmony, line, shape size, texture, color, idea Rhythm - definition, methods of obtaining rhythm repetition of shapes, progression of size, continuous line movements **Emphasis –** definition, how to emphasis grouping of objects, using contrasting color, using decoration, having sufficient plain background, using unusual lines, shapes & size Anthropometric data- Standard dimensions of human body in different postures Standard dimension of furniture			
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Interior Materials:			

Floor covering carpets, types & fixing of carpets

Finishes- Walls & Furniture finishing likes paint, wallpaper paneling & cladding

Furnishing materials - cloth, Rexene, leather, etc. curtains,

Plastics - Study of types of plastics, casting, molding process, use in interiors

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Furniture - Movable furniture like chairs, tables, fixed furniture like wall units, wardrobe, kitchen platform, partitions, Upholstered furniture like sofa sets, chairs etc.

Lighting, study of types of lighting, Direct & Indirect lighting, study of different wiring systems & their suitability

Construction:

Partition – wooden partition, aluminum partitions, sound proofing partitions

False ceiling, different types of false ceiling systems in different materials

Text Books:

1. Interior Design Principles and Practice by M. Pratap Rao, 4th edition, 2017.
2. Interior Design by S. N. Chaudhari, Aviskar Publisher, ISBN: 9788179101667
3. Building Material, P. C. Vargeesh, PHI Learning Pvt. Ltd.

Reference Books:

1. Time Saver Standards for Interior Design and Space Planning, by Joseph De Chiara, 2017
2. The Interior Design Reference & Specification Book updated & revised: Everything Interior Designers Need to Know Every Day by Chris Grimley and Mirni Love, Rockport publishers, 2018

Engineering Economy, Estimation & Costing LAB

LAB COURSE OUTLINE

Course Title:	***Engineering Economy, Estimation & Costing Lab***	**Short Title:**	*EEEC LAB*	**Course Code:**	

Course description:

Estimating and costing is a core syllabus of civil engineering which needs practical treatment. This subject already has a theory paper. However it is essential for the students to practice a lot with real world examples. The present syllabus includes this aspect. Here, a student has to find estimated cost of variety of contemplated structures using standard procedures and DSR. Some part of the syllabus is dedicated to economics also which again is a very important aspect of civil engineering where projects cost millions and billions of Rs. The treatment is preliminary and gives emphasis on practical approach.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	*14*	*28*	*5*

End Semester Exam (ESE) Pattern:	***Oral (OR)***

Prerequisite course(s):

Nil

Course objectives:

The objectives of the course are :

1. To enable student with working out quantities of various items involved in construction of structures based upon detailed drawings.
2. To enable student to carry out the rate analysis
3. To enable student to carry out valuation of existing property considering depreciation.
4. To enable students to draft the specifications for new civil work.

Course outcomes:

Upon successful completion of lab Course, student:

1. Attain the level of proficiency to prepare approximate as well as detailed estimate of civil engineering projects.
2. Will be competent enough to calculate the amount of material, labor & machinery required to execute any civil construction projects
3. Will be well trained to make bills of venders of civil construction works
4. Will be able to perform and evaluate present worth of a property.
5. Will be able to assess the future worth & annual worth analyses on one of more economic alternatives.

LAB COURSE CONTENT

Engineering Economy, Estimation & Costing Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

Term work Assignments:

1. An approximate estimate for a multistoried building by approximate method
2. Detailed Estimate for :- (*any 3*)
   i. Ground plus three storied RCC framed building with block work walls
   ii. R. C C Bridge with minimum two span
   iii. Factory Building
   iv. Road Works
   v. Cross Drainage Works
   vi. Ground plus three storied building with Load bearing walls
3. Rate analysis and Specifications for (*any 3)*
   i. Excavation work

ii. RCC work

iii. Brick masonry work

iv. Plastering both internal & external

4.Prepartion of Bar Bending Schedule (BBS) (*any2)*

i. RCC footing, Column, Beam & slab

ii. R C C Retaining wall

iii. RCC Doglegged Stair case

5. Detailed estimate on Minor Structure like (*any1*)

i. Box Culvert

ii. , Earthen Bund

iii. Single Toilet Block with Septic tank

Text Books:

1. Dutta B N, Estimating & Costing in civil engineering UBS Publishers
2. Estimating, Costing, Specifications & Valuation in Civil Engineering, by M. Chakraborti, M Chakraborty Publications.
3. Birde G. S., Text book of estimating & costing, Dhanpatrai publishing

Reference Books:

Quantity Surveyor's Pocket Book, Duncan Cartilidge, BH Publications.

Guide lines for ICA:

ICA will be based upon the assignments done by the student.

Guidelines for ESE:

The ESE will be based upon the viva voce given by the student on his/her term work.

Advanced Surveying Lab

COURSE OUTLINE

Course Title:	*Advanced Surveying Lab*	**Short Title:**	*ASL*	**Course Code:**	

Course description:

This course introduce the students about concept in surveying such as Scope of geodetic surveying and triangulation in civil engineering society, Adjustment of triangulation figure by using different methods, Terrestrial and aerial photography for large scale survey, Principles of remote sensing and its methods, Locating of sounding in hydrographic surveying, Importance and principles of Total station, Setting of curves on roads and railways.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	14	28	02
Laboratory	*02*	*14*	*28*	

Prerequisite course(s):

Nil

Course objectives:

1. Indentify and calculate the theory of errors in measurement in Triangulation survey
2. To operate an Total station to perform all measurement.
3. Calculate air base distance, overlap, and height of object in photographs.
4. Relate the knowledge gained after using nautical sextant in hydrographic survey.
5. To setting out the curves on roads and railways.
6. To relate the knowledge about Geodetic survey.

Course outcomes:

After successful completion of this course the student will be able to:

1. To be able to conduct Geodetic survey in remote areas.
2. To be able to determine probable error and its determination , distribution of error to the field measurements , adjustment of a geodetic triangle.
3. To be able to identify aerial photos with respect to overlap , air base distance , tone lithology.
4. To be able to carry hydrographic survey, soundings.
5. To be able to setting out curves on roads and railways.

COURSE CONTENT

Advanced Surveying Lab		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Theory:	**2 hours/week**	**End semester exam (ESE):**	**25**
Practical:	**2 hours/week**	**Internal Sessional Exams (ICA:**	**25**

Unit–I:	**No. of Lectures: 04 Hours**	

Geodetic surveying :

Objects and methods in geodetic surveying. Triangulation figure, strength of figure, classification of triangulation system, Selection of stations , inter visibility of height of station towers, signals and their classification, phase signals, satellite station and reduction to centre eccentricity of signals , Base line measurement , apparatus used, base net; equipment used for base line measurement, extension of base .

Unit–II:	**No. of Lectures: 05 Hours**	

Triangulation Adjustments :

Kinds of errors, laws of weights, determination of the most probable values f quantities , the method of least squares, indirect observations on independent quantities , normal equation , conditioned quantities, The probable error and its determination , distribution of error to the field measurements , methods of correlates , station adjustment , adjustment of a geodetic triangle, figure adjustment of a triangle calculation of spherical angles, adjustment of geodetic quadrilateral , adjustment of a quadrilateral with a central station by method of least squares

Unit–III:	**No. of Lectures: 05 Hours**	

Photogrammetry:

Objects, application to various fields , terrestrial photogrammetry and aerial photogrammetry, aerial camera, comparison of map and vertical photographs, classification of photographs , concept of principal point, nadir point, isocentre, horizon point, principal plane , Scale of vertical photograph ,computation of length and height from the photograph, relief displacement on vertical photograph , Mirror and lens stereoscopes.

Unit–IV:	**No. of Lectures: 05 Hours**	

Hydrographic surveying and Remote sensing :

Objects, establishing controls, shore line survey , river survey, soundings tide gauges, equipments for taking soundings signals, Nautical sextant measurement of horizontal and vertical angles with the nautical sextant, methods of locating soundings .

Basic principles ,definition , importance scope of remote sensing, sensors and its classifications, platforms, applications of remote sensing, electromagnetic radiation and spectrum multispectral scanner MSS, black body radiation , atmospheric windows. Study and use of Total station.

Unit–V:	**No. of Lectures: 08 Hours**	

Curves :

Horizontal and vertical curves and their purposes, simple circular curves its elements and setting out by linear and angular methods, Compound curves and its elements and setting out of compound curves, Transition curves its types and uses length ,elements of cubic parabola, Introduction to reverse curves and its elements and uses.

Following experiments are to be performed. Term works shall consist of journal giving details of the experiments performed.

1. Measurement of horizontal and vertical angles by One Second Theodolite

a. Study the component parts of One Second Theodolite.

b. Measurement of horizontal angles by face left and right position.

c. Measurement of vertical angles by face left and right position.

2. Measurement of horizontal angles by reiteration method.

a. Measurement of horizontal angles by face left and right position.

b. Verification of check by reiteration method.

3. Study and use of mirror stereoscope and finding out the air base distance

a. Find out the location of principal point on photograph

b. Fix the photograph along the line of principal point and conjugate principal point

c. Measurement of air base distance by mirror sterescope

4. Hydrographic survey

i) Study and use of nautical sextant for measurement of angles.

a. Study of components parts of nautical sextant

b. Measurement of horizontal, vertical and oblique angle

4. Measurement of angles and elevation by Total Station

a. Study of components parts of total station

b. Measurement of horizontal and vertical angles by total station

c. Measurement of vertical elevation by total station

d. Measurement of horizontal distance by total station.

Note: The practical examination will be based on the above exercises.

Text Books:

1. Surveying and leveling (vol-I&II) by T.P. Kanitkar, & S.V. Kulkarni, Pune Vidarthi Griha Prakashan, Pune,
2. Surveying Vol. I ,Vol .II and III ,by Dr B.C.Punmia,Ashok K Jain, Arun K Jain , Laxmi Publication (P) New Delhi.
3. Principles of surveying by Cliver and clendening
4. Advance surveying , Vol.I & II, Handbook by P.B. Shahani
5. A handbook of accurate surveying methods by S.P.Collins

6 Surveying by, S K Duggal , Vol.I & II, McGraw Hill Education (India) private Limited New Delhi.

7 Introduction to Geographic information systems, by Kang- tsung Chang, McGraw Hill Education (India) private Limited New Delhi.

8 Surveying by, C L Kochher , Dhanpat Rai publicating co. New Delhi

Reference Books:

1. Advance surveying by P.Som , B.N.Ghosh, TMH Publication.
2. Surveying and leveling , by N N Basak, Vol.I & II,McGraw Hill Education (India) private Limited New Delhi.
3. Elements of Photogrammetry by Paul Richard Wolf, McGraw-Hill Education (India) Pvt Limited.
4. Plane and geodetic surveying by David Clark, J. E. Jackson
5. Principal of remote sensing by A. N. Patel
6. Concept and techniques of Geographic Information System , by C P LO Albbert K W Yeung ,Prentice Hall of India Private Limited , New Delhi.

Major Project Stage II

LAB COURSE OUTLINE

Course Title:	**Major Project**	**Short Title:**	**MPROJ**	**Course Code:**	

Course description:

Major project is a step towards learning by doing. A group of students are provided a guide. The group identifies a real world problem. They seek the solution by literature survey, case study, simulations, experimentation, analysis etc. It offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	6	**14**	**84**	**3**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Nil

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.

3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT			
Minor Project		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**End semester exam (ESE): (OR)**	**25 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

In continuation with Major Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the student should complete implementation of ideas as formulated in Major Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Major Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering

(Computer Engineering / Information Technology)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII & VIII

W.E.F. 2021 – 22

Syllabus Structure for Final Year Engineering (Semester – VII) (Computer / Information Technology) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Complier Design	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Complier Design Lab	D	-	-	2	2	-	-	25	25 (PR)	50	1
Advanced Technology Lab - I	D	1	-	2	3	-	-	25	25 (PR)	50	2
Project (Stage – I)	G	-	-	12	12	-	-	50	50 (OR)	100	6
Essence of Indian Traditional Knowledge	H	-	-	-	-	-	-	-	-	-	-
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Machine Learning	1	Data Mining	1	Human Resource Management
2	Internet of Things	2	Distributed Systems	2	Industrial Engineering
3	Ad-Hoc and Sensor Networks	3	Cloud Computing	3	Quantitative Reasoning and Problem Solving
4	Virtual Reality	4	Human Computer Interaction	4	Entrepreneurship Development

Syllabus Structure for Final Year Engineering (Semester – VIII) (Computer / Information Technology) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Cyber Security	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3
Cyber Security Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1
Advanced Technology Lab - II	D	2	-	2	4	-	-	25	25 (PR)	50	3
Project	G		-	6	6	-	-	50	50 (OR)	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V		Professional Elective Course – VI		Open Elective Course – IV	
1	Soft Computing	1	Data Analytics	1	Ethical Practices in Business
2	Advanced Operating Systems	2	Blockchain	2	Total Quality Management
3	Mobile Computing	3	Quantum Computing	3	Logical Reasoning and Problem Solving
4	Business Analytics and Intelligence	4	Information Retrieval	4	Robotics

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Final Year Engineering

(Computer Engineering / Information Technology)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester - VII

W.E.F. 2020 – 21

Compiler Design

COURSE OUTLINE

Course Title:	**Compiler Design**	**Short Title:**	**CD**	**Course Code:**	

Course description:

This course is aimed at introducing the fundamentals of Compiler Design to undergraduate students.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**14**	**42**	**3**

Prerequisite course(s):

Formal Language & Automata Theory

Course objectives:

1. To learn phases of Compiler.
2. To understand parsing techniques.
3. To learn Syntax-Directed Translation and Intermediate-Code generation.
4. To understand Run-Time Environments.
5. To learn Code Generator.

Course outcomes:

After successful completion of this course the student will be able to:

1. Design Lexical Analyzer.
2. Design Syntax Analyzer.
3. Generate Intermediate Code.
4. Illustrate different storage management schemes.
5. Design Code Generator

COURSE CONTENT

Compiler Design		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Introduction: Language Processors, The Structure of a Compiler, Applications of Compiler Technology

Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, The Lexical -Analyzer Generator Lex

Syntax Analysis: Introduction, Top-Down Parsing: Recursive-Descent Parsing, FIRST and FOLLOW, LL(l) Grammars, Nonrecursive Predictive Parsing, Error Recovery in Predictive Parsing

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Bottom-Up Parsing: Reductions, Handle Pruning, Shift-Reduce Parsing, Conflicts During Shift-Reduce Parsing **Introduction to LR Parsing:** Simple LR, Why LR Parsers?, Items and the LR(O) Automaton, The LR-Parsing Algorithm, Constructing SLR-Parsing Tables, Viable Prefixes **More Powerful LR Parsers:** Canonical LR(l) Items, Constructing LR(l) Sets of Items, Canonical LR(l) Parsing Tables, Constructing LALR Parsing Tables, Efficient Construction of LALR Parsing Tables, Compaction of LR Parsing Tables, **Parser Generators:** The Parser Generator Yacc, Using Yacc with Ambiguous Grammars, Creating Yacc Lexical Analyzers with Lex, Error Recovery in Yacc		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Syntax-Directed Translation: Syntax-Directed Definitions: Inherited and Synthesized Attributes, Evaluating an SDD at the Nodes of a Parse Tree, Evaluation Orders for SDD's: Dependency Graphs, Ordering the Evaluation of Attributes, S-Attributed Definitions, L-Attributed Definitions, Semantic Rules with Controlled Side Effects, Applications of Syntax-Directed Translation: Construction of Syntax Trees, The Structure of a Type, Syntax-Directed Translation Schemes: Postfix Translation Schemes, Parser-Stack Implementation of Postfix SDT's, SDT's With Actions Inside Productions, Eliminating Left Recursion From SDT's, SDT's for L-Attributed Definitions **Intermediate-Code Generation:** Variants of Syntax Trees: Directed Acyclic Graphs for Expressions, The Value-Number Method for Constructing DAG's, Three-Address Code: Addresses and Instructions, Quadruples, Triples, Static Single-Assignment Form		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Run-Time Environments: Storage Organization: Static Versus Dynamic Storage Allocation, Stack Allocation of Space: Activation Trees, Activation Records, Calling Sequences, Variable-Length Data on the Stack **Heap Management:** The Memory Manager, he Memory Hierarchy of a Computer, Locality in Programs, Reducing Fragmentation, Manual Deallocation Requests Introduction to Garbage Collection: Design Goals for Garbage Collectors, Reachability, Reference Counting Garbage Collectors **Introduction to Trace-Based Collection:** A Basic Mark-and-Sweep Collector, Basic Abstraction, Optimizing Mark-and-Sweep, Mark-and-Compact Garbage Collectors, Copying collectors, Comparing Costs		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Code Generation: Issues in the Design of a Code Generator : Input to the Code Generator, Instruction Selection, Register Allocation, Evaluation Order **The Target Language:** A Simple Target Machine Model, Program and Instruction Costs **Basic Blocks and Flow Graphs:** Basic Blocks, Next-Use Information, Flow Graphs, Representation of Flow Graphs, Loops **Optimization of Basic Blocks:** The DAG Representation of Basic Blocks, Finding Local Common Subexpressions, Dead Code Elimination, The Use of Algebraic Identities, Representation of Array References, Pointer Assignments and Procedure Calls , Reassembling Basic Blocks From DAG's		

Simple Code Generator: Register and Address Descriptors , The Code-Generation Algorithm, Design of the Function getReg **Peephole Optimization:** Eliminating Redundant Loads and Stores, Eliminating Unreachable Code, Flow-of-Control Optimizations, Algebraic Simplification and Reduction in Strength, Use of Machine Idioms **Register Allocation and Assignment:** Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring
Text Books:
1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman- "Compilers- Principles, Techniques and Tools", 2nd edition, Pearson, 2014.
Reference Books:
1. K. Cooper, L, Torczon, "Engineering a Compiler", Morgan Kaufinann Publishers 2. K. Louden, "Compiler Construction: Principles and Practice", Cengage Learning 3. J. R. Levine, T. Mason, D. Brown, "Lex &Yacc", O'Reilly, 2000 4. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005

Machine Learning (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Machine Learning**	**Short Title:**	**ML**	**Course Code:**	

Course description:

This course provides a broad introduction to machine learning, Topics include Supervised learning, Unsupervised learning, Best practices in machine learning. The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to building smart robots (perception, control), text understanding computer vision, medical informatics, audio, database mining, and other areas.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**14**	**42**	**3**

Prerequisite course(s):

Artificial Intelligence, Neural Network

Course objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.
3. To gain skills for solving practical problems by machine learning.

Course outcomes:

After successful completion of this course the student will be able to:

1. Recognize the characteristics of machine learning that make it useful to real-world problems.
2. Able to use regularized regression and Classification algorithms.
3. Evalute machine learning algorithms and model selection.
4. Understand scalable machine learning and machine learning for IoT.
5. Understand Deep leaning and Expert system.

COURSE CONTENT

Machine Learning		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Machine Learning: Types of Machine Learning Algorithms, Supervised Learning, Unsupervised learning, Reinforcement Learning, Classification of Machine Learning Concept, Distance Based Machine learning Methods, K-Nearest Neighbor (kNN).

Introduction to Clustering Techniques, Possible Applications, Requirements of clustering algorithm, Types of Clustering Methods, Clustering Strategies.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Classification / Regression: Classifications, decision tree learning, naive bayes, linear regression, logistic regression, Linear regression models, support vector machine, beyond binary classifications: multiclass or multinomial classification.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Evaluating machine learning algorithms and model selection: Machine Learning Algorithms, Designing Machine Learning Algorithms, Classification Metrics Regression Metrics, Statistical Learning Theory, Ensemble Methods, What is Random Forest **Sparse modeling and estimation**: Time series, Deep (Structured) Learning, Neural Network, Applications of Deep Learning Methods, Feature Representation Learning.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Scalable machine learning: Semi-Supervised Machine Learning, Semi-Supervised Learning, When Can Semi-Supervised Learning Work?, Active (Machine) Learning, Graphical Model, Inference on Graphical Models, Probabilistic Graphical Models (PGM). **Machine learning & IoT :** Internet of Things, Emergence of Internet of Things, The Architecture of IoT, Machine Learning Algorithm for IoT, Internet of Things Communication Protocols, The IoT Architectural Reference Model, Taxonomy of Machine Learning Algorithms		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Deep Learning : Neurons, Linear Perceptrons as Neurons, Neural Nets Architecture/ Design, Working of Neural Nets, Layers of Neural Networks and Deep learning, Activation Functions, Feed Forward Neural Networks, Limitations of Neurons Deep Belief Networks (DBNs) Large Scale DBNs, Large Scale Convolutional Neural Networks, Deep Learning for Big Data, Deep Learning from High Volumes of Data, Deep Learning from High Variety of Data ,Deep Learning for High Velocity of Data ,Local Minima in Deep Networks, Rearranging Neurons in a layer of a Neural Network, Spurious Local Minima in Deep Networks. **Expert System**: Characteristics, Components, Development, Knowledge Engineering, Application.		
Text Books:		
1. V.K. Jain, Machine Learning, Khanna Publishing House. 2. Rajiv Chopra, Deep Learning. 3. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI.		
Reference Books:		
1. Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi. 2. Mitchell Tom, Machine Learning. McGraw Hill, 1997. 3. Ethem Alpaydin, Introduction to Machine Learning, PHI.		

Internet of Things (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Internet of Things**	**Short Title:**	**IoT**	**Course Code:**	

Course description:

This course develops a foundation of concepts and solutions that supports the project planning & management concepts. Describe how to managing development of project by applying project management concepts. Project risk management provides students with an organized approach for managing the uncertainties that can lead to undesirable project outcomes. Course topics include: Project procurement management and post project analysis.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the design principles for connected devices
2. Understand the design principles of Internet connectivity
3. Analyze the concepts of knowledge acquiring, managing and storing
4. Understand the wide variety of sensors
5. Design the software for IoT applications

COURSE CONTENT

Internet of Things		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Internet of Things: An Overview: Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT

Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets
Internet Connectivity Principles: Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes,
Data Collection, Storage and Computing Using Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology
Prototyping the Embedded Devices for IoT and M2M: Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs
IoT Privacy, Security and Vulnerabilities Solutions: Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT

Text Books:

1. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

Reference Books:

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi

Ad-Hoc and Sensor Networks (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Ad-Hoc and Sensor Networks**	**Short Title:**	**ASN**	**Course Code:**	

Course description:

The course introduces advanced concepts in wireless networking covering all important design issues, routing, transport layer, security and energy management in Ad-Hoc wireless networks. Some recent related important topics are also introduced such as wireless sensor networks, hybrid wireless networks and pricing in multi-hop wireless networks.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Knowledge of Data Communication and Computer Networking

Course objectives:

The course deals with knowledge of different methods in ad-hoc and sensor networks. The objective of the course is to introduce ad-hoc and sensor networks and their need in future advanced wireless networks.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basic concepts and applications of ad-hoc and sensor networks.
2. Analyze and discuss routing protocols for wireless ad-hoc networks.
3. Describe routing protocols for hybrid wireless networks.
4. Illustrate transport layer solutions for ad-hoc networks.
5. Explain the concepts of sensor network architecture.

COURSE CONTENT

Ad-Hoc and Sensor Networks		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Ad Hoc Wireless Networks:

Introduction: Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme, Routing, Multicasting, Transport Layer Protocols, Pricing Scheme, Quality of Service Provisioning, Self-Organization, Security, Addressing and Service Discovery, Energy Management, Scalability, Deployment Considerations, Ad Hoc Wireless Internet, Energy Management in Ad Hoc Wireless Networks: Introduction, Need for Energy Management in Ad Hoc Wireless Networks, Classification of Energy Management Schemes

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Routing Protocols for Ad Hoc Wireless Networks:
Introduction, Issues in designing a routing protocol : Mobility, Bandwidth Constraint, Error-Prone Shared Broadcast Radio Channel, Hidden and Exposed Terminal Problems, Resource Constraints, Characteristics of an Ideal Routing Protocol, Classification of Routing Protocols, Table-Driven Routing Protocols, On Demand Routing Protocols, Hybrid Routing Protocols: ZRP, Power-Aware Routing Protocols

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Hybrid Wireless Networks:
Introduction, Routing in Hybrid Wireless Networks: Base-Assisted, Base-Driven Multi-hop Bridging, SMCN, DWiLL Routing Protocols, Pricing in Multi-Hop Wireless Networks: Issues in Pricing, Pricing in Military Ad Hoc Wireless Networks, Pricing in Multi-Hop Wireless WANs, Pricing in Ad Hoc Wireless Networks, Open Issues in Pricing, Power Control Schemes in Hybrid Wireless Networks, Issues in Using Variable Power in IEEE 802.11, Power Optimization Scheme

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Transport Layer and Security Protocols for Ad Hoc Wireless Networks:
Introduction, Issues in designing a Transport Layer Protocol, Design Goals, Classification of Transport Layer Solutions, TCP over Ad Hoc Wireless Networks, Security, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Wireless Sensor Networks:
Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, Location Discovery, Quality of Sensor Network, Evolving Standards, Other Issues

Text Books:

1. Ad Hoc Wireless Networks: Architectures and Protocols by C. Siva Ram Murthy and B.S. Manoj, Pearson Education, 2nd Edition (LPE), 2004.

Reference Books:

1. Guide to Ad Hoc Networks by Editors Sudip Misra, Issac Woungang and Subhash Chandra Misra, Springer, 2009.

Virtual Reality (Professional Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Virtual Reality**	**Short Title:**	**VR**	**Course Code:**	
Course description:					
Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Fundamentals knowledge of Computer Graphics

Course objectives:

1. To understand Geometric modeling and Virtual environment.
2. To understand Geometric Transformations.
3. To learn Animation for the Virtual Environment.
4. To Know about Virtual Hardware and Software
5. To learn Virtual Reality applications.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe Geometric modeling and Virtual environment.
2. Use Geometric Transformations for creation of various geometric objects
3. Apply knowledge of Animation for the Virtual Environment.
4. Explain Virtual Hardware and Software
5. Analyze Virtual Reality applications.

COURSE CONTENT			
Virtual Reality		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark .3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer ,the perspective projection, human vision, stereo perspective projection, 3D clipping, Color theory.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, radiosity,

Hidden Surface Removal, Realism-Stereographic image. Geometric Modeling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection. Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Animating the Virtual Environment: Introduction, The dynamics of numbers, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems.VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML.VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction		
Text Books:		
1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.		
Reference Books:		
1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000. 2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006. 3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008.		

Data Mining (Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Data Mining**	**Short Title:**	**DM**	**Course Code:**	

Course description:

This course is designed to expand students' knowledge and skills gained in database management courses and look in depth at data warehousing and data mining methods. The course examines the database architecture and technologies required for solving complex problems of data and information management, information retrieval, and knowledge discovery facing modern organizations.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**14**	**42**	**3**

Prerequisite course(s):

Database Management System

Course objectives:

1. To introduce students to the basic concepts and techniques of Data Mining.
2. To develop skills of using recent data mining software for solving practical problems.
3. To gain experience of doing independent study and research.
4. To study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems.
5. Develop and apply critical thinking, problem-solving, and decision-making skills.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand Data Warehouse fundamentals, Data Mining Principles.
2. Describe different steps in data preprocessing used for data mining.
3. Characterize the kinds of patterns that can be discovered by mining.
4. Apply different data-mining technique for classification of data.
5. Categorize and carefully differentiate between cluster and outlier analysis.

COURSE CONTENT

Data Mining		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction: What Is a Data Warehouse? Differences between Operational Database Systems and Data Warehouses, But, Why Have a Separate Data Warehouse?, What Is Data Mining?, What Kinds of Patterns Can Be Mined?: Class/Concept Description: Characterization and Discrimination, Mining Frequent Patterns, Associations, and Correlations, Classification and Regression for Predictive Analysis, Outlier Analysis, Major Issues in Data Mining: Mining

Methodology, User Interaction, Efficiency and Scalability, Diversity of Database Types, Data Mining and Society.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Data Preprocessing :
Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization .

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Mining Frequent Patterns : Basic Concepts, Apriori Algorithm: Finding Frequent Item sets by Confined Candidate Generation, Generating Association Rules from Frequent Item sets, Mining Multilevel Associations, Constraint-Based Frequent Pattern Mining.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Classification by Back-propagation, Support Vector Machines, Lazy Learners, Other Classification Methods.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Cluster Analysis :
Basic Concepts and Methods, Partitioning Methods, Hierarchical Methods : Agglomerative versus Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN, Grid-Based Methods : STING, Outliers and Outlier Analysis

Text Books:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 3rd edition (July 2011).
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining. Pearson (2005).

Reference Books:

1. T. Hastie, R. Tibshirani and J. H. Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction. Springer, 2nd Edition, 2009.
2. C. M. Bishop, Pattern Recognition and Machine Learning. Springer, 1st edition, 2006

Distributed System (Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Distributed System**	**Short Title:**	**DS**	**Course Code:**	

Course description:

The aim of this course is to introduce the students, a clear description of the fundamental concept and design principles that underlie distributed OS. It does not concentrate on any particular distributed OS or hardware. Instead the course discusses various fundamental concepts which are applicable to variety of distributed OS.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Operating System, Computer Network

Course objectives:

1. To acquire the basic knowledge of Distributed System.
2. To gain knowledge to understands Remote Procedure Calls and the concept of shared memory.
3. To know synchronization and process Management in Distributed Operating System.
4. To understand distributed file system along with it's model and Naming.
5. To acquire knowledge of resource Management in Distributed Operating System.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe fundamentals of distributed computing system along with message passing.
2. Explain Remote Procedure Calls and understands Distributed shared memory.
3. Describe synchronization, Election Algorithm and Process Management, with role of threads.
4. Discuss distributed file system along with it's model and Naming.
5. Justify resource management and scheduling algorithm.

COURSE CONTENT

Distributed System		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals: What is a distributed computing system, Evolution of distributed computing systems, Distributed computing system models, Why are distributed computing system gaining popularity, What is distributed operating system, Issues in designing a distributed operating system.

Message Passing: Introduction, Desirable feature of good message-passing system, Issues in IPC by message passing, Synchronization, Buffering, Multidatagram messages, Encoding and decoding of message data, Process addressing, Failure handling, Group communication.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Remote Procedure Calls: Introduction, Basic RPC operation, Parameter passing, Asynchronous RPC, The RPC model, Transparency of RPC, Implementing RPC mechanism, Stub generation, RPC messages, Marshaling arguments and results, Server management, Parameter-passing semantics, Call semantics, Communication protocol for RPC. **Distributed Shared Memory:** Introduction, General architecture of DSM systems, Design and implementation issues of DSM, Granularity, Structure of shared memory space, Consistency models, Replacement strategy, Thrashing.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Synchronization: Introduction, Clock synchronization, Berkeley algorithm, Lamport's logical clock, Event ordering, Mutual exclusion, Election algorithms – Traditional election algorithms, Elections in wireless environments **Process Management:** Introduction, Process Migration (Code Migration) – Desirable features of a good process migration mechanism, process migration mechanisms, process migration in heterogeneous systems, advantages of process migration , Reasons for migrating code, models for code migration, migration and local resources. **Threads-** Motivations for using threads, Models for organizing threads, Issues in designing a threads package, Implementing a threads packages.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Distributed File Systems: Introduction, Desirable features of a good Distributed file system, File models, File-accessing models, File-sharing semantics, File-catching schemes, File replication. **Naming:** Introduction, Desirable features of a good naming system, Fundamental technologies and concepts, System-oriented names, Object-locating mechanisms.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Resource Management: Introduction, Desirable features of a good global scheduling algorithm, Task assignment approach, Load-balancing approach, Load-sharing approach.		
Text Books:		
1. Pradeep. K. Sinha, “Distributed Operating Systems - Concepts and Design” , PHI, Eastern Economy Edition. 2. Andrew S. Tanenbaum and Maarten Van Steen, “Distributed Systems - Principles and Paradigms”, Second edition , PHI, Eastern Economy Edition.		
Reference Books:		
1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems - Concepts and Design”, Fourth edition, Pearson Education.		

<table>
<tr><td colspan="6" align="center">Cloud Computing (Professional Elective Course – IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Cloud Computing</td><td>Short Title:</td><td>CC</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course gives different aspects of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Cloud computing provides adaptive Virtualisation techniques such as VMWare, Xen, Microsoft Hyper-V. Also provides the awareness of Cloud Platforms in Industry.</td></tr>
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Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**14**	**42**	**3**

Prerequisite course(s):

Operating Systems, Computer Network

Course objectives:

1.To understand different characteristic of cloud computing and computing platforms.
2. To analyze Principles of Parallel and Distributed Computing.
3.To learn Virtualization.
4. To understand cloud service model.
5. To learn industry case study of cloud computing platform.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe fundamental knowledge of cloud computing.
2. Analyze the Cloud Principles of Parallel and Distributed Computing.
3. Apply and design suitable Virtualization concept.
4. Analyze cloud computing architecture.
5. Discuss societal issues by addressing Cloud Platforms in Industry.

COURSE CONTENT

Cloud Computing		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction: Cloud computing at a glance, The vision of cloud computing, Defining a cloud, A closer look, The cloud computing reference model, Characteristics and benefits, Challenges ahead, Historical developments, Distributed systems, Virtualization, Web 2.0, Service-oriented computing, Utility-oriented computing, Building cloud computing environments, Application development, Infrastructure and system development, Computing platforms and technologies.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Principles of Parallel and Distributed Computing: Eras of computing, Parallel vs. distributed computing, Elements of parallel computing, What is parallel processing?, Hardware architectures for parallel processing, Approaches to parallel programming, Levels of parallelism, Laws of caution, Elements of distributed computing, General concepts and definitions, Components of a distributed system, Architectural styles for distributed computing, Models for interprocess communication, Technologies for distributed computing, Remote procedure call, Distributed object frameworks, Service-oriented computing.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Virtualization: Introduction, Characteristics of virtualized environments, Increased security, Managed execution, Portability, Taxonomy of virtualization techniques, Execution virtualization, Other types of virtualization, Virtualization and cloud computing, Pros and cons of virtualization, Advantages of virtualization, The other side of the coin: disadvantages, Technology examples, Xen: paravirtualization, VMware: full virtualization, Microsoft Hyper-V.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cloud Computing Architecture: Introduction, The cloud reference model, Architecture, Infrastructure- and hardware-as-a-service, Platform as a service, Software as a service, Types of clouds, Public clouds, Private clouds, Hybrid clouds, Community clouds, Economics of the cloud, Open challenges, Cloud definition, Cloud interoperability and standards, Scalability and fault tolerance, Security, trust, and privacy, Organizational aspect.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Cloud Platforms in Industry: Amazon web service, Compute services, Storage services, Communication services, Additional services, Google AppEngine, Architecture and core concepts, Application life cycle, Cost model, Observations, Microsoft Azure, Azure core concepts, SQL Azure, Windows Azure platform appliance, Observations.		
Text Books:		
1. R. Buyya,Christian Vecchiola and S Thamarai Selvi Mastering Cloud Computing, Tata McGraw-Hill		
Reference Books:		
1. Anthony T.Velte, Toby J.Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010 2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011		

Human Computer Interaction (Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Human Computer Interaction**	**Short Title:**	**HCI**	**Course Code:**	

Course description:

Human–computer interaction is a specialty in many fields, and is therefore multidisciplinary, but it has an intrinsic relationship as a subfield to computer science. Most interactive computing systems are for some human purpose and interact with humans in human contexts.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**15**	**42**	**3**

Prerequisite course(s):

Software Engineering

Course objectives:

1. To design effective and usable Human Computer Interfaces.
2. To describe and apply core theories from the field of HCI.
3. To Learn the concepts of Interaction Design
4. To learn the Software process used for HCI

Course outcomes:

After successful completion of this course the student will be able to:

1. Evaluate the basics of human and computational abilities and limitations.
2. Inculcate basic theory, tools and techniques in HCI.
3. Apply the fundamental aspects of designing and evaluating interface.
4. Apply appropriate HCI techniques to design systems that are usable by people
5. Design the HCI Software process.

COURSE CONTENT

Human Computer Interaction		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

The Human: Input Output Channels, Human Memory, Thinking, Emotion, Individual Differences, Psychology and the design of interactive systems.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

The Computer: Introduction, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Design Focus: Readability of text, Memory, Processing and networks

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

The Interaction: Introduction, Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity, The context of the Interaction, Experience, engagement and fun, Paradigms for interaction		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Interaction Design Basics: Introduction, What is design? , The process of design, User focus: Design Focus: Cultural probes, Scenarios, Navigation design: Design Focus: Beware the big button trap, Design Focus: Modes, Screen design and layout: Design Focus: Alignment and layout matter, Design Focus: Checking screen colors, Iteration and prototyping		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
HCI in the Software Process: Introduction: The software life cycle, Usability engineering, Iterative design and prototyping: Design Focus: Prototyping in practice, Design rationale. Design rules: Introduction, Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns		
Text Books:		
1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9		
Reference Books:		
1. Jenny Preece, Rogers, Sharp, “Interaction Design-beyond human-computer interaction”, WILEY-INDIA, ISBN 81-265-0393-9 2. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904. 3. Mary Beth Rosson and John M. Carroll, “Usability Engineering: Scenario-Based Development of Human-Computer Interaction”, Morgan Kaufmann, 2001		

Human Resource Management (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Human Resource Management**	**Short Title:**	**HRM**	**Course Code:**	

Course description:

This course helps the students to develop an understanding of the concept & techniques of essential functions of human resource management. This course will use and focus on Indian experiences and approaches for human resource management.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To know the function, objective and principle policies of HRM.
2. To understand different strategies, planning and challenges of HRM.
3. To gain knowledge for the nature of job analysis.
4. To know the recruitment process and evaluation of selection process.
5. To understand ethical issues and ethical dilemmas in HRM.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain policies and principles of Human Resource Management.
2. Define strategy of management and planning of HRM.
3. Determine job analysis, design and evaluation of HRM.
4. Use their right talent in recruitment process.
5. Measure ethical issues, audit and evaluation in Human Resource Management.

COURSE CONTENT

Human Resource Management		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Human Resource Management: Nature of HRM, Functions & Objectives of HRM, Personal policies and principles of HRM, HRM models: The Fombrun- Tichy and Devanna Model, The Harvard Model, The Guest Model, The Warwick Model, The Ulrich Model. Jobs and Careers in HRM: HR Specialist, HR Manager, Head-HR, HR Business Partner, HR Shared Services Expert.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Strategy Management and Planning of HRM: Strategic Management, Strategic Management

Process, Strategic Human Resource Management (SHRM), Strategic HRM versus Conventional HRM, Benefits of Strategic HRM, Challenges of Strategic HRM. Nature of HRP, Importance of HRP, Factors affecting HRP, Barriers to HRP.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Job Analysis, Design and Evaluation: Nature of Job Analysis, Job Analysis and Competitive Advantage, The Process of Job Analysis, Job Analysis and Strategic HRM, Potential Problems with Job Analysis. Job Design, History of Job Design, Significance of Job Design, Factors Affecting Job Design, Job Design Approaches. Job Evaluation: Scope, Process, Pitfalls and Alternatives.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Recruiting and Selecting Right Talent: Nature of Recruitment, Factors Governing Recruitment, Recruitment Process, Evaluation and Control, Philosophies of Recruiting. Selecting Right Talent: Nature of Selection, Selection Process, Barriers to Effective Selection, Evaluation of Selection Process.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Ethical Issues, Audit and Evaluation in HRM: Sources of Ethics, Importance of Ethics, Ethical Dilemmas, Ethical Issues in HRM, Managing Ethics. Nature and Need of HR Evaluation, Principles of Evaluation, Evaluation Framework, Approaches to Evaluation.

Text Books:

1. K. Aswathappa, “Human Resource Management Text and Cases”, Eight Edition, Tata McGraw Hill Education.

Reference Books:

1. Raymond Noe, Raymond Andrew Noe, John Hollenbeck, Barry Gerhart, Patrick M. Wright, *“*Humna Resource Management*”,* McGraw-Hill Irwin.
2. DeCenzo, David A. and Robbins, Stephen P., ― Fundamentals of Human Resource Management‖, John Wiley and Sons, Inc. New York.
3. Human Resource Management, Text & Cases by Dr. V.S.P Rao - Excel Books.

Industrial Engineering (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Industrial Engineering**	**Short Title:**	**IE**	**Course Code:**	
Course Description:					
Industrial engineering is actually a far-ranging profession that focuses on optimizing complex processes or systems by reducing wastefulness in production.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Prerequisite Course(s):

Course Objectives:

1. To introduce the concepts, principles and framework of contents of Industrial Engineering.
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Production Planning and Control and
4. Facility Design.
5. To introduce the concepts of various cost accounting and financial management practices as applied in industries.
6. To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
7. To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Apply the Industrial Engineering concept
2. Understand, analyze and implement different concepts involved in method study.
3. Describe the implementation of work and time study at a workplace
4. Analyze various forecasting techniques and their relevance to problems.
5. To identify, formulate and solve engineering problems.

COURSE CONTENT

Industrial Engineering		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 08 hours**	**Marks: 12**
Definition and Role of Industrial Engineering, Types of production systems and		

organization structure, Functions of management. Measurement of productivity: Factors affecting the productivity, Productivity Models and Index, Productivity improvement techniques viz. 5S, Kaizen, TPS, KANBAN, JIT, etc.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Work Study: Definition, objective and scope of work-study, Human factors in work-study. Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids. Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts. Principles of motion economy, classification of movements, SIMO chart, and micro motion study. Introduction to Value Engineering and Value Analysis.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Work Measurements: Definition, objectives and uses, Work measurement techniques. Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems. Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.		
Unit – IV:	**No. of Lectures: 09 hours**	**Marks: 12**
Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II. Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality, Demand Control strategies. Introduction to Supply Chain Management: Basic terminologies.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate. Material Handling: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment. Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.		
Text Books:		
1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co. 2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication 3. MartendTelsang, Industrial Engineering, S. Chand Publication. 4.Banga and Sharma, Industrial Organization& Engineering Economics, Khanna		

publication.
Reference Books:
1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008. 2. H.B.Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw HillEducation. 3. Askin, Design and Analysis of Lean Production System, Wiley, India 4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002 5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press; 3rd New edition (2010). 6. Barnes, Motion and time Study design and Measurement of Work, Wiley India

Quantitative Reasoning and Problem Solving (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Quantitative Reasoning and Problem Solving**	**Short Title:**	**QRPS**	**Course Code:**	

Course description:

A quantitative Reasoning is used for various professions to check the numeric ability and problem solving ability of the test taker. There is hardly any vocation in the world where a basic numeric ability is not needed. It is important for any job seeker to understand basic mathematical functions needed in day- to- day commercial operations

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. Use appropriate mathematical and statistical language in oral, written, and graphical forms.
2. Think critically about mathematical models for relationships between different quantities and use those models effectively and accurately to solve problems and reach sound conclusions about them.
3. Interpret and analyze various representations of data.

Course outcomes:

After successful completion of this course the student will be able to:

1. Perform arithmetic calculations on number system, HCF and LCM and age
2. Solve application problems involving Time, Distance, Speed.
3. Calculate Time Taken at varies case.
4. Calculate percentage, average and simple interest.
5. Classify data as categorical or quantitative.

COURSE CONTENT

Quantitative Reasoning and Problem Solving		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of EE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Number System: Fundamental Concepts, Tests of Divisibility, Factorial of number, Modulus of a number, Greatest integral Value, Multiplication by Short cut method, Division algorithm.
Highest Common Factor and Least Common Factor: Factors and Multiples , Factorization method, Division Method ,HCF and LCM of fractions, HCF and LCM of decimal Fractions.

Problems on Ages : Ratio Based Age Problems, Equation Solving Type Age Problems, Finding Ratio Between Ages

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Time and Distance: Unit Conversion Time And Distance Problems, Average Speed When Travelling To A Place And Returning, Problems Based On Changing Time And Changing Speed.

Problem on Trains: Important facts and Formulae, Time taken by train to pass pole/standing man / Signal post, relative Speed of trains/ bodies moving in same direction, cross time of trains/bodies moving in opposite direction, Cross time trains/ bodies moving in same direction with different speed, reaching time of two trains/ bodies start at the same time from point A and B towards each other destination.

Problem on Boat: Speed of downstream, Speed of upstream, Speed in still water, Rate of stream, Speed of the man in still water.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Time and Work: Calculate Time to Complete Work by 2 or More People, Equations Based Time and Work Problems, Efficiency Based Time and Work Problems, Calculate Time When Efficiency is Given in Percentage, Calculate Time When Workers Leave in Between, Share of Salary Based on Work.

Pipes and Cisterns: Important Facts and Formulae, Calculate Time Taken to Fill a Tank By 2 or More Pipes, Calculate Time Taken to Fill a Tank With Leakage, Equations Based Pipes and Cistern Problems, Calculate Time Taken When Pipes Are Opened For Different Periods, Calculate Number of Pipes.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Percentage: Concepts of percentage, Results on population, Result on depreciation, Salary Comparison Percentage Problems, Appreciation And Depreciation Based Percentage Problems, Price And Consumption Based Percentage Problems, Set Theory Formula Based Percentage Problems.

Average: Number Series Summation Based Averages, Consecutive Even/Odd Type Problems, Change In Average Based Problems, Multiple Groups Based Average Problems, Distance And Speed Based Averages.

Simple Interest: Important Fact and Formulae, Simple Interest Formula Based Direct Problems, Compound Interest Formula Based Direct Problems, Difference Between Compound And Simple Interests, Direct Problems With Both SI And CI.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Data Interpretation: Tabulation, Bar Graph, Pie Chart, Line graph, Problem on data Data Interpretation: Sum and Difference based, Average based questions, percentage based questions.

Text Books:

1. Dr. R.S. Aggarwal "Quantitative Aptitude" S. Chand Publication, Revised Edition 2017

Entrepreneurship Development (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Entrepreneurship Development**	**Short Title:**	**ED**	**Course Code:**	
Course description:					
This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To introduce the aspects of Entrepreneurship.
2. To acquaint with legalities in product development.
3. To know the facets of functional plans.
4. To understand the Entrepreneurial Finance Management.
5. To know about the Launching a Venture and Managing growth.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the aspects of Entrepreneurship
2. Understand the legalities in product development.
3. Understand and apply business plans and marketing strategy.
4. Understand and apply Finance plan.
5. Inculcate managerial skill as an entrepreneur.

COURSE CONTENT

Entrepreneurship Development		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Entrepreneurship: Entrepreneurship, Resource Organization and Value Creation, Entrepreneurial Traits, Difference between Inventors and Entrepreneurs, Business Model, Entrepreneurship—Mindset, Big Companies Vs Start-ups, Misconceptions and Myths about Entrepreneurship.

Entrepreneurship Development in Emerging Markets: Types of Start-up, Intrapreneurship, Why does One Become an Entrepreneur?, Entrepreneurship as a Career Option, Female Entrepreneurship, Mistakes Start-ups Make, Managing Start-ups during Downturn, Entrepreneurship—Emerging Trends in the Global Knowledge.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Entrepreneurial Leadership: Entrepreneurial Leadership, Components of Entrepreneurial Leadership.
Creativity and Business Ideas: Creativity and Entrepreneurship, Generating Business Idea-Sources of New Ideas, Techniques for Generating Ideas.
Legal Aspects of Business: Formation of Business Entity, Requirements for Incorporation of a Private/Public Limited Company.
Entrepreneurship and Intellectual Property Rights: Patents Trademarks and Copyrights.
Business Plan: Entrepreneurial Opportunities and Business Plan, Business Plan Drivers, Business Failures.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Marketing Plan: Marketing Research, Benefits of Undertaking Marketing Research**,** Factors Affecting the Decision to Undertake Marketing Research, Scope and Steps Involved in Marketing Research, Industry Analysis, Competitor Analysis, Define Target Market, Market Segmentation, Market Positioning, Building A Marketing Plan, Marketing Mix, Critical Factors For Devising A Market Strategy.
Venture Team And Organizational Plan – Building an Effective Venture Team, Venture Team Development, Designing Organization Structure and Systems, Designing an Effective Organizational Structure.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Insight from Financial Statements: Meaning And Objectives of Financial Statement, Assumptions Underlying Preparation of Financial Statement, Profit and Loss Account/Income Statements, Ratio Analysis.
Financing Venture: Sources of Finance, Seed Funding, Venture Capital Funding, Funding from Banks, Lease Financing, Funding Opportunities for Startups in India.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Launching a Venture: Steps Involved in Launching a Business, Incorporation and Issuance of Stocks, Execute a Stockholders' Agreement, Raise Different Resources Including Finance on Time, Leverage of Intellectual Property, Build a Winning Team, Motivating and Inspiring the Team, Understand Clearly the Technology Trends, Prepare Pilot Testing, Manage Sales by a Clear Understanding—Market Marketing Strategies and Positioning, Record Keeping of Expenses, To-do Checklist—Daily, Weekly and Monthly, Managing Cash, Due Diligence, Scheduling—Implementation Plan.
Managing Growth: Growth Sources, Venture Development Stages, How Fast can a Venture Grow?, Management—Key Factors for Growth, Managerial Issues—Growth of a Venture, Why Entrepreneurs do not Scale up, Tips for Growth of a Venture, Growth Strategies for Ventures.
Start-up to Going Public: What is an IPO?, When to Go for an IPO?, Steps Involved in Issuing an IPO, Selection of Intermediaries to the IPO, Rating of IPOs, Marketing Strategies for IPO, Misconceptions about IPOs.

Text Books:

1. Kumar, Arya, "Entrepreneurship: Creating and Leading an Entrepreneurial Organization", Pearson 2012.
Reference Books:
1. Hishrich., Peters, "Entrepreneurship: Starting, Developing and Managing a New Enterprise, McGraw-Hill Education Tenth Edition. 2. Charantimath, Poornima, "Entrepreneurship Development and Small Business Enterprises", Pearson Education, Second Edition.

Compiler Design Lab

LAB COURSE OUTLINE

Course Title:	**Compiler Design Lab**	**Short Title:**	**CDL**	**Course Code:**	

Course description:

Compiler Design Lab course provides a practical approach to build phases of compiler.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Formal Language and Automata Theory

Course objectives:

1. To learn LEX and YACC tools.
2. To build Lexical Analyzer and Syntax Analyzer.
3. To build Intermediate-Code Generator.
4. To implement Predictive Parser.
5. To implement Deterministic Finite Automata.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate LEX and YACC tools.
2. Design Lexical Analyzer.
3. Design Syntax Analyzer.
4. Design Code Optimization.
5. Design Code Generator

LAB COURSE CONTENT

Compiler Design Lab		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Concerned faculty member should suitably frame THREE laboratory assignments from Group - A and THREE Laboratory assignments from Group – B from the following list.

Group A

1. Implement a lexical analyzer for a subset of C using LEX Implementation should support Error handling
2. Implement a lexical analyzer of identification of numbers (Numbers can be binary, octal, decimal, hexadecimal, float or exponential)
3. Write an ambiguous CFG to recognize an infix expression and implement a parser that

recognizes the infix expression using YACC. Provide the details of all conflicting entries in the parser table generated by LEX and YACC and how they have been resolved
4. Implement a Calculator using LEX and YACC.
5. Implementation of Syntax Tree

Group B

1. Implementation of Context Free Grammar
2. Design of a Predictive parser
3. Implementation of code generator
4. Implementation of code optimization for Common sub-expression elimination, Loop invariant code movement.
5. Implement Deterministic Finite Automata

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. J. R. Levine, T. Mason, D. Brown, "Lex &Yacc", O'Reilly, 2^{nd} Edition
2. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman- “Compilers- Principles, Techniques and Tools”, 2nd edition, Pearson, 2014.

Reference Books:

1. K. Cooper, L, Torczon, "Engineering a Compiler", Morgan Kaufinann Publishers
2. K. Louden, "Compiler Construction: Principles and Practice", Cengage Learning
3. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.
Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Advanced Technology Lab - I

LAB COURSE OUTLINE

Course Title:	**Advanced Technology Lab - I**	**Short Title:**	**ATL - I**	**Course Code:**	

Course description:

The course focuses on practical hands-on of recent technologies.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**1**	**14**	**14**	**2**
Laboratory	**2**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Programming Language
Database Management Systems
Computer Network

Course objectives:

To enhance competency by undertaking laboratory assignments using Full Stack.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Break down real world problems / application.
2. Demonstrate Full Stack development.
3. Design Full Stack based applications.
4. Decide tools for Full Stack development.
5. Develop Full Stack based applications.

LAB COURSE CONTENT

Advanced Technology Lab - I		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Theory:	**1 hour/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Concerned faculty member should suitably frame Three Laboratory assignments using Full Stack (Front End, Back End and Database) by considering the technological aspects, utility and recent trends. The assignments should be based on real world problems / application. The assignments and / or tools in the Full Stack may be framed per individual student or group of students. The assignments may also be based on professional elective course opted by individual student or group of students in the current semester, but must be based on real world problems / application. For better understanding of various facets of different Full Stacks, it is expected that the assignments should be implemented using more than one Full Stacks.

Following are the suggested list of tools but not limited to:

Operating System
- 64-bit Open source Linux or its derivative or Windows

Programming Languages: C++ / C# / JAVA / PYTHON / R

Programming tools:
- Front End: Java / Perl / PHP / Python / Ruby / .NET / HTML / Wordpress / Drupal / Javascript / JQuery / Laravel Blade / MeteorJS / AngularJS / ReactJS / VueJS etc.
- Backend: C / C++ / Java / Java Spring / Java Swing / Node JS / Ruby / Python / .NET / PHP/ Laravel etc.
- Database: MongoDB / MYSQL / Oracle / SQL Server, Database Connectivity: ODBC / JDBC etc.

Some of the Full Stack:
- LAMP / WAMP stack: JavaScript - Linux - Apache - MySQL - PHP
- LEMP / WEMP stack: JavaScript - Linux - Nginx - MySQL - PHP
- MEAN stack: JavaScript - MongoDB - Express - AngularJS - Node.js
- Django stack: JavaScript - Python - Django - MySQL
- Ruby on Rails: JavaScript - Ruby - SQLite - Rails

For each laboratory assignment, Software Engineering approach with proper documentation is required.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

Reference Books:

Online web Resources

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project (Stage – I)

LAB COURSE OUTLINE

Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	

Course description:

Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	12	14	168	6

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Practical:	**12 hours/week**	**End Semester Exam (ESE): OR**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement’s Specification (SRS)
- Summary

Chapter 4. Design

- System Arch
- Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:
Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:
Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, "Traditional knowledge system in India", Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, "Traditional Knowledge System and Technology in India", Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, "Indian Art and Culture", McGraw Will Publication.
4. Dr. Bramhand Tripathi, "Charak Sanhita", Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, "Sushrut Samhita"
6. Valiatham M.S., "An Introduction to Ayurveda" Orient Bkackswan Publication.
7. Valiathan M.S., "The legacy of Charaka" University Press.
8. Valiathan M.S., "The legacy of Susruta" University Press.
9. Garg Maheshwari, "Ancient Indian Architecture", CBS Publisher and Distributors
10. Sharmin Khan, "History of Indian Architecture", CBS Publisher and Distributors.

11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Final Year Engineering
(Computer Engineering / Information Technology)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE
Semester - VIII
W.E.F. 2021 – 22

Cyber Security					
COURSE OUTLINE					
Course Title:	**Cyber Security**	**Short Title:**	**CS**	**Course Code:**	

Course description:

Cyber Security course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Computer Network

Course objectives:

1. To understand Cybercrime and Cyberoffenses.
2. To understand Cybercrime through portable devices.
3. To understand tools and methods used in Cybercrime.
4. To understand Phishing and Identity theft.
5. To understand Computer Forensics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Determine the act of Cyberoffenses.
2. Determine the Cybercrime through portable devices.
3. Determine the methods used in Cybercrime.
4. Determine Phishing and Identity theft.
5. Describe Computer Forensics.

COURSE CONTENT

Cyber Security		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes

Cyberoffenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless

Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft) **Understanding Computer Forensics:** Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics		
Text Books:		
1. Nina Godbole and Sunil Belapure, “Cyber Security”, Wiley India Publication, 2014		
Reference Books:		
1. Nina Godbole , Information Systems Security , Wiley India Publication 2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition		

Soft Computing (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Soft Computing**	**Short Title:**	**SC**	**Course Code:**	

Course description:

Soft computing refers to a consortium of computational methodologies. Some of its principal components include Fuzzy Logic, Neural Networks, and Genetic algorithms, all having their roots in Artificial Intelligence. In today's highly integrated world, when solution to problems are cross-disciplinary in nature, soft computing promises to become a powerful means for obtaining solution to problems quickly.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**15**	**42**	**3**

Prerequisite course(s):

Artificial Intelligence, Neural Networks

Course objectives:

1. To know the basics behind the Design and development intelligent systems in the framework of soft computing
2. To acquire knowledge of Neural Networks
3. To acquire knowledge of Fuzzy sets and Fuzzy Logic
4. To acquire knowledge of Genetic algorithm
5. To explore the applications of soft computing

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply soft computing methodologies includes neural network
2. Apply soft computing methodologies includes fuzzy logic
3. Apply soft computing methodologies includes genetic algorithm
4. Apply soft computing methodologies includes hybrid system
5. Design of certain scientific and commercial application using soft computing approach

COURSE CONTENT

Soft Computing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Soft Computing: Soft Computing, Hard computing, Three Technologies of Soft Computing, Neural Networks, Fuzzy Logic and Genetic Algorithms, Fundamentals of Neural Networks: Human Brain, Model of Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods. Backpropagation Networks: Architecture of a Backpropagation Network

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Basic concepts of fuzzy logic: Fuzzy versus Crisp, Crisp sets: operations, properties, Fuzzy sets: Membership function, basic fuzzy set operations, properties of fuzzy sets, Crisp relations: Cartesian product, Fuzzy relations: fuzzy Cartesian product, Fuzzy Systems: Crisp logic: Laws of propositional logic, Inference in propositional logic, Fuzzy logic: fuzzy quantifier, fuzzy inference, Fuzzy rule based system		

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Genetic Algorithms: fundamental, history, basic concepts, creation of Offsprings, Working principal, Encoding: binary encoding, Octal encoding, Hexadecimal encoding, Permutation encoding, Value encoding, Tree encoding, Fitness function, Reproduction: Roulette wheel selection, Boltzman selection, Tournament selection, Rank selection, steady state selection.		

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Genetic Modeling: Inheritance operators, Cross over: single site, Two point, Multi point, Uniform, Matrix, cross over rate, Inversion and deletion: Inversion, deletion and duplication, deletion and regeneration, Segregation, Cross over inversion, Mutation operator: Mutation, Mutation rate, Bitwise operators: One's complement operator, Logical Bit-wise operator, Shift operator, Bit-wise operators Used in GA, Generational cycle, Convergence of Genetic algorithm, difference and similarities between GA and other traditional methods, Advances in GA		

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Hybrid Systems and Applications: Sequential hybrid systems, auxiliary hybrid systems, Embedded hybrid systems, Neuro-Fuzzy hybrid, Neuro-Gentic hybrid, fuzzy-Genetic hybrid, GA based backpropagtion networks: coding, weight extraction, fitness function, reproduction, convergence, Applications of neural networks in character recognition and classification of soil, Applications of fuzzy logic in Greg viot's fuzzy cruise controller and air conditioner controller		

Text Books:

1. S. Rajsekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" , Prentice Hall of India

Reference Books:

1. S.N. Sivanandam- "Principles of Soft Computing", 2nd Edition, Wiley India- ISBN-9788126527410
2. S R Jang, CT Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing" , PHI PVT LTD, ISBN 0-13-261066-*3*.
3. De Jong , "Evolutionary Computation: A Unified Approach", Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006
4. Maurice Clerc, "Particle Swarm Optimization", ISTE, Print ISBN:9781905209040 |Online ISBN:9780470612163 |DOI:10.1002/9780470612163
5. Siman Haykin, "Neural Networks", Prentice Hall of India, ISBN: 0-7923-9475-5
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley India, ISBN: 978-0-470-74376-8

Advanced Operating System (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Advanced Operating System**	**Short Title:**	**AOS**	**Course Code:**	

Course description:

The aim of this course is to introduce the students, the basic foundation in the design of advanced operating systems. The emphasis of the course is on various alternative approaches to the solution of the problems encountered in the design of advanced operating systems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Operating System
Computer Network

Course objectives:

1. To acquire the basic knowledge of Advanced Operating Systems and architectures of distributed operating system.
2. To gain knowledge of Distributed deadlock detection algorithms.
3. To know the distributed scheduling concept and fault tolerance.
4. To understand the resource security with its protection and data security.
5. To study Multiprocessor system architectures and multiprocessor operating systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe the concept of advanced operating systems and architectures of distributed systems.
2. Explain Distributed deadlock detection mechanisms and agreement protocols for distributed systems.
3. Discuss about the distributed scheduler with key issues such as load distribution & load balancing along with failure and recovery in distributed system.
4. Summarize the concept of fault tolerance, resource security and protection.
5. Describe Cryptography and multiprocessor system architectures along with multiprocessor operating systems.

COURSE CONTENT

Advanced Operating System		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Overview: Introduction, Functions of an operating system, Design approaches, Why advanced

operating systems, Types of advanced operating systems,
Architecture of Distributed Operating Systems: Introduction, Motivations, System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Networks, Communication Primitives,

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Distributed Deadlock Detection: Introduction, Preliminaries, Deadlock handling strategies in distributed systems, Issues in deadlock detection and resolution, Control organizations for distributed deadlock detection, Centralized deadlock detection algorithms, Distributed deadlock detection algorithms, Hierarchical deadlock detection algorithms, Perspective.
Agreement Protocols: Introduction, The system model, A classification of agreement problems, Solutions to the Byzantine agreement, Applications of agreement algorithms,

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Distributed Scheduling: Introduction, Motivation, Issues in load distributing, Components of load distributing algorithm, Stability, Load distributing algorithms, Performance comparison, Selecting a suitable load sharing algorithm, Requirements for load distributing, Task migration, Issues in task migration,
Recovery: Introduction, Basic concepts, Classification of failures, Backward and forward error recovery, Backward-error recovery - basic approaches, Recovery in concurrent systems, Consistent set of checkpoints, Synchronous checkpointing and recovery, Asynchronous checkpointing and recovery,

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Fault Tolerance: Introduction, Issues, Atomic action and committing, Commit protocols, Nonblocking Commit protocols, Voting protocols, Dynamic voting protocols, The majority based dynamic voting protocols, Dynamic vote reassignment protocols, Failure resilient processes, Reliable communication.
Resource security and protection - Access and flow control: Introduction, Preliminaries, The access matrix protocol, Implementation of the access matrix, Safety in the access matrix model, Advanced models of protection,

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Data Security - Cryptography: Introduction, A model of cryptography, Conventional cryptography, modern cryptography, Private key cryptography: Data encryption standard, Public key cryptography, Multiple encryption, Authentication in distributed systems.

Multiprocessor System Architectures: Introduction, Motivations for multiprocessor systems, Basic multiprocessor system architectures, Interconnection networks for multiprocessor systems, Caching, Hypercube architectures.

Multiprocessor operating systems: Introduction, Structures of multiprocessor operating systems, Operating system design issues, Threads, Process synchronization, Processor scheduling, Memory management – The Mach operating system

Text Books:
1. Mukesh Singhal and Niranjan G. Shivaratri, “ Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems” , Tata McGraw-Hill Edition
Reference Books:
1. Pradeep. K. Sinha, “Distributed Operating Systems - Concepts and Design”, PHI, Eastern Economy Edition. 2. Andrew S. Tanenbaum and Maarten Van Steen, “Distributed Systems - Principles and Paradigms”, Second edition , PHI, Eastern Economy Edition.

Mobile Computing (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Mobile Computing**	**Short Title:**	**MC**	**Course Code:**	

Course description:

Fundamentals of Mobile Computing explains revolutionary and rapidly evolving paradigm for Computing: mobile users seamlessly interacting with wireless devices embedded in environment. Recognizing the increasing dominance mobile devices, networks and applications, this mobile centric perspective gives today's student the inside track on tomorrow's solutions and opportunities.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Computer network.

Course objectives:

1. Student will learn basic concepts of mobile computing.
2. Students will understand mobility management in wireless network.
3. Student will explore to mobile middleware and its types in mobile environment.
4. Students will understand various security issue in mobile network

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the basic concepts of mobile computing
2. Understand the data dissemination and management in mobile computing
3. Analyze various mobile middleware techniques used in mobile computing
4. Evaluate various security approaches used in wireless network.
5. Use various security approaches in mobile environment.

COURSE CONTENT

Mobile Computing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mobile Adaptive Computing: What Is Mobile Computing? Adaptability—The Key to Mobile Computing, Transparency, Constraints of mobile computing environments, Application-aware adaptation, Mechanisms for Adaptation: Adapting functionality, Adapting data

How to Develop or Incorporate Adaptations in Applications?: Where can adaptations be performed? Support for Building Adaptive Mobile Applications: Odyssey, Rover

Mobility Management, Location Management Principles and Techniques, Registration area–based location management, Location Management Case Studies, PCS location management scheme, Mobile IP

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Data Dissemination and Management: Challenges, Data Dissemination: Bandwidth allocation for publishing Broadcast disk scheduling, Mobile Data Caching: Caching in traditional distributed systems, Cache consistency maintenance , Performance and architectural issues, Mobile Cache Maintenance Schemes: A taxonomy of cache maintenance schemes, Cache maintenance for push-based information dissemination , Broadcasting invalidation reports, Disconnected operation , Asynchronous stateful (AS) scheme , To cache or not to cache? Mobile Web Caching: Handling disconnections, Achieving energy and bandwidth efficiency. Context-Aware Computing: Ubiquitous or Pervasive Computing, What Is a Context? Various Definitions and Types of Contexts: Enumeration-based, Role-based, Context-Aware Computing

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Introduction to Mobile Middleware: What is Mobile Middleware? Adaptation, Agents, Service Discovery, Middleware for Application Development: Adaptation and Agents, Adaptation: The spectrum of adaptation, Resource monitoring, Characterizing adaptation strategies, An application-aware adaptation architecture: odyssey A sample odyssey application, More adaptation middleware, Mobile agents, Service Discovery Middleware: Finding Needed Services: services, more on Discovery and Advertisement protocols, Garbage Collection, Eventing.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Wireless Security: Traditional Security Issues, Mobile and Wireless Security Issues, Mobility, Problems in Ad Hoc Networks, Additional Issues: Commerce, Additional Types of Attacks, Approaches to Security: Limit the Signal: Wire integrity and tapping, Physical limitation, Encryption: Public and private key encryption, Computational and data overhead, Integrity Codes: Checksum versus cryptographic hash, Message authentication code (MAC), Payload versus header, Traffic analysis, IPSec, Authentication header (AH), Encapsulating security payload (ESP), Security-Related Mechanisms: Authentication protocols, AAA, Special Hardware

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Security in Wireless Local Area Networks: Basic Idea, Wireless Alphabet Soup, Wired-Equivalent Privacy (WEP):WEP goals, WEP data frame, WEP encryption, WEP decryption, WEP authentication, WEP flaws, WEP fixes, WPA,
Security in Wide Area Networks: CDMA, GSM: GSM authentication, GSM Encryption, Problems with GSM Security: session life, Weak encryption Algorithm, Encryption between mobile host and base station only, Limits to secrete Key, The four generation of wireless:1G-4G

Text Books:

1. Frank Adelstein, Sandeep K.S Gupta , “Fundamentals of Mobile & Pervasive Computing ”,

TMH (2005)
Reference Books:
1. Asoke K Talukder , Hasan Ahmed , RoopaYavagal, “Mobile Computing: Technology, Applications and Service Creation”, TMH (2010) 2. Jochen Schiller , "Mobile Communications," Addison-Wesley (2009)

Business Analytics and Intelligence (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Business Analytics and Intelligence**	**Short Title:**	**BAI**	**Course Code:**	

Course Description:

This course aims at providing information system with comprehensive knowledge of business intelligence principles and techniques and expose students to the frontiers of BI-intensive BIG data computing and information system.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite Course(s):

1. Fundamentals of Data Mining.
2. Knowledge of Artificial Intelligence

Course Objectives:

1. To introduce concept of computerized decision support system, data analytics and business intelligence.
2. To know the impact of business reporting, information visualization and dashboards.
3. Select software tools for knowledge management systems in business organizations
4. To understand the fundamentals of Big Data Analytics.
5. To know the impacts of analytics in organizations.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Understand the aspects of computerized decision support system, data analytics and business intelligence.
2. Understand the impact of business reporting, information visualization and dashboards.
3. Understand and apply Model-Based Decision Making and Knowledge Management
4. Understand and apply the Fundamentals of Big Data Analytics.
5. Understand the Impacts of Analytics in Organizations

COURSE CONTENT

Business Analytics and Intelligence		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

An Overview of Business Intelligence, Analytics, and Decision Support: Managerial Decision Making, Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A Framework for Business Intelligence (BI), Business Analytics Overview, Brief Introduction to Big Data Analytics.

Foundations and Technologies for Decision Making: Decision Making: Introduction and Definitions, Phases of the Decision-Making Process, Decision Making: The Intelligence Phase, Decision Making: The Design Phase, Decision Making: The Choice Phase, Decision Making: The Implementation Phase, How Decisions Are Supported, Decision Support Systems: Capabilities, DSS Classifications.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Business Reporting, Visual Analytics, and Business Performance Management: Business Reporting Definitions and Concepts, Data and Information Visualization, Different Types of Charts and Graphs, The Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Business Performance Management, Performance Measurement, Balanced Scorecards, Six Sigma as a Performance Measurement System.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Model-Based Decision Making: Optimization and **Multi-Criteria Systems:** Decision Support Systems Modeling, Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Decision Modeling with Spreadsheets, Mathematical Programming Optimization, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.

Knowledge Management and Collaborative Systems: Introduction to Knowledge Management, Approaches to Knowledge Management, Information Technology (IT) in Knowledge Management, Making Decisions in Groups: Characteristics, Process, Benefits, and Dysfunctions, Supporting Group work with Computerized Systems, Tools for Indirect Support of Decision Making, Direct Computerized Support for Decision Making: From Group Decision Support Systems to Group Support Systems

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Big Data and Analytics: Definition of Big Data, Fundamentals of Big Data Analytics, Big Data Technologies, Data Scientist, Big Data and Data Warehousing, Big Data Vendors, Applications of Stream Analytics.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Business Analytics: Emerging Trends and Future Impacts: Location-Based Analytics for Organizations, Location-Based Analytics for Organizations, Recommendation Engines, Web 2.0 and Online Social Networking, Cloud Computing and BI, Impacts of Analytics in Organizations: An Overview, Issues of Legality, Privacy, and Ethics, An Overview of the Analytics Ecosystem.

Text Books:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015.

Reference Books:

1. Business Process Automation, Sanjay Mohapatra, PHI.
2. Introduction to business Intelligence and data warehousing, IBM, PHI.

Data Analytics (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Data Analytics**	**Short Title:**	**DA**	**Course Code:**	

Course description:

Data Analysis is an ever-evolving discipline with lots of focus on new predictive modeling techniques coupled with rich analytical tools that keep increasing our capacity to handle big data.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**15**	**42**	**3**

Prerequisite course(s):

Data Mining

Course objectives:

1. To understand the concepts of big data
2. To understand the concepts of Data science
3. To do the data analysis
4. To apply the concepts of data visualization
5. To apply data analytics tools

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of big data
2. Understand the concepts of Data science
3. Do the data analysis
4. Apply the concepts of data visualization
5. Apply data analytics tools

COURSE CONTENT

Data Analytics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Big Data: Big data, 3V's, 4 V's of big data, Types of Big data, Analytics, Industry examples of Big data, Data risk, Big data technologies, Big data architecture, operational and analytical big data technologies, big data and eGovernance, Benefits of Big data, analytics and cloud computing, Crowd sourcing analytics.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Data Science: Data Science, Terminology Related with Data Science, Methods of Data Repository, Personnel Involved with Data Science, Types of Data, The Data Science Process (DSP), Popular Data Science Toolkits, Familiarity with Example Applications

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Data Analysis: Introduction to Applied Statistical Techniques, Types of Statistical Data, Types Of Big Data Analytics, Collecting Data for Sampling and Distribution, Probability, Frequency Distribution, Population and Parameters, Central Tendency or Central Value, Measures Of Central Tendency, Different Types of Statistical Means, Problems of Estimation : Population or Sample, Normal Distribution Curve		

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Data Visualization: Data Visualization, Importance of Data Visualization, Conventional Data Visualization Methods, Retinal Variables, Mapping Variables to Encodings, Case Study, Recent trends in various data collection and analysis techniques, Various Big Data Visualization Tools, Visualizing Big Data, Preattentive Attributes, Challenges of Big Data Visualization, Potential Solutions, Future Progress of Big Data Visualization		

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Advanced Analytics: Technology and Tools: Hadoop: Architecture, components of Hadoop framework, Analysing big data with Hadoop. MapReduce: Overview, Map Operations, HIVE: features, architecture, working, data models. PIG: Introduction, components, pig vs MapReduce, Pig vs HIVE,		

Text Books:

1. V.K.Jain, “Data Science and Analytics”, Khanna Book Publishing Co.(P) LTD. Edition 2018
2. V.K.Jain, “Big Data and Hadoop”, Khanna Book Publishing Co.(P) LTD. Edition 2017

Reference Books:

1. Maheshwari Anil, Rakshit, Acharya, “Data Analytics”, McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication,ISBN: 978-1-118-16430-3
3. David Dietrich, Barry Hiller, “Data Science and Big Data Analytics”, EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
4. Ashutosh Nandeshwar , “Tableau Data Visualization Codebook”, Packt Publishing, ISBN 978-1-84968-978-6
5. Luís Torgo, “Data Mining with R, Learning with Case Studies”, CRC Press, Talay and Francis Group, ISBN9781482234893
6. Carlo Vercellis, “Business Intelligence - Data Mining and Optimization for Decision Making”, Wiley Publications, ISBN: 9780470753866.

Blockchain (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Blockchain**	**Short Title:**	**BC**	**Course Code:**	

Course description:

The aim of this course is to introduce the fundamental concepts of Blockchain. Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. It has applications in finance, government, media and almost all other industries.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Data Structures and Algorithms

Course objectives:

1. To provide conceptual understanding of how blockchain technology can be used to innovate and improve business processes.
2. To cover the technological underpinning of blockchain operations in both theoretical and practical implementation of solutions using blockchain technology.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the structure of a blockchain and why/when it is better than a simple distributed database
2. Discuss security aspects in blockchain through cryptography.
3. Describe how Cryptocurrency mining works.
4. Write smart contract using Ethereum frameworks and Hyperledger Fabric .
5. Integrate ideas from various domains and develop block chain based solutions.

COURSE CONTENT

Blockchain		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction:
Distributed systems: CAP Theorem, Byzantine General Problem, Consensus, History of Blockchain, Introduction to Blockchain, Generic Elements of blockchain, Features of blockchain, Applications of Blockchain, Tiers of blockchain, Types of blockchain, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Cryptography in Blockchain:
Cryptographic primitives, Symmetric cryptography: Stream cipher, Block Ciphers, Data Encryption standard, Advanced Encryption Standard, Asymmetric cryptography, Public and private keys: RSA, Discrete Logarithm problem, Hash functions, Secure Hash Algorithms, Merkle Trees, Patricia Trees, Distributed Hash Table, Digital Signatures

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Understanding Block chain with Crypto currency:
Bitcoin definition, Transactions: life cycle, structure and types of transaction, Blockchain: structure of a block, structure of a block header, The genesis block: Mining , Task of miners, synching up with the network, Proof of Work, Mining Algorithms, Hashing rate, Mining Systems, Mining Pools, Bitcoin Network, Bitcoin Limitations

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Smart Contracts and Ethereum:
Smart Conracts: History, Definition, Ricardian contracts: Smart contract templates, Smart Oracles, Deploying smart contract on Blockchain
Ethereum: Introduction, Ethereum blockchain, Elements of Ethereum blockchain, Precompiled contracts, Accounts, Block, Genesis Block, Transaction validation and execution, The block validation mechanism: block finalization, Ether, Messages, Mining, Mining Rings, Mining Pools

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Hyperledger and Block chain outside of Currencies:
Hyperledger Fabric : Architecture , Membership, Blockchain services: consensus manager, distributed ledger, peer to peer protocol, Ledger Storage, Components of Fabric: Peers, Applications on Blockchain,
Blockchain outside of Currencies: Internet of Things, Government, Health, Finance, Media

Text Books:

1. Imran Bashir, “Mastering Block Chain: Deeper insights into decentralization, cryptography, Bitcoin and popular Blockchain frameworks”, Packt Publishing

Reference Books:

1. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
2. Josh Thompsons, “Blockchain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”
3. Daniel Drescher, “Blockchain Basics”, Apress; 1 st edition, 2017
4. Anshul Kaushik, “Blockchain and Crypto Currencies”, Khanna Publishing House, Delhi.
5. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing
6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Blockchain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018

Quantum Computing (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Quantum Computing**	**Short Title:**	**QC**	**Course Code:**	
Course description:					
Quantum computing is the introductory course. The basic concepts like quantum computing basics , quantum bits, quantum computation, quantum information theory, Correlation between computer science and quantum computing, information theory, and cryptography are covered.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Basic knowledge of Mathematics

Course objectives:

1. To understand basic concepts of quantum computing
2. To learn quantum search algorithms
3. To apply quantum information for solving real world problem

Course outcomes:

After successful completion of this course the student will be able to:

1. To understand the basic concepts of quantum computing.
2. To understand quantum algorithms
3. To understand the concept of quantum communication
4. To understand the security of information in quantum computing.
5. To know the basic requirements for implementation of quantum computers.

COURSE CONTENT

Quantum Computing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Fundamental concepts

Introduction and overview, Global perspectives, Quantum bits, Quantum computation, Quantum algorithms, Experimental quantum information processing, Quantum information, Quantum information in a wider context.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Quantum Mechanics

Linear algebra, The postulates of quantum mechanics, Application: super dense coding The density operator, The Schmidt decomposition and purifications, EPR and the Bell inequality

Unit–III:	No. of Lectures: 10 Hours	Marks: 12
Introduction to computer science Models for computation, The analysis of computational problems, Perspectives on computer science **Quantum computation** Quantum circuits, Quantum algorithms, Single qubit operations, Controlled operations Measurement, Universal quantum gates, Summary of the quantum circuit model of computation, Simulation of quantum systems.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Quantum computers: physical realization Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics Iontraps, Nuclear Magnetic Resonance, Other implementation schemes		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Quantum information theory Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels Entanglement as a physical resource, Quantum cryptography		
Text Books:		
1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information” , Cambridge University Press		
Reference Books:		
1. Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008. 2. N. David Mermin, "Quantum Computer Science", Cambridge 2007		

Information Retrieval (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Information Retrieval**	**Short Title:**	**IR**	**Course Code:**	

Course description:

This course provides basics of information retrieval and in particular the heart of search engines, processing of Boolean queries, augmentation of inverted index for functionality and speed, search structures for dictionaries, algorithms for constructing the inverted index, techniques for compressing dictionaries, and evaluation of an information retrieval system based on the relevance of documents.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Data structures and algorithms

Course objectives:

Enable students to understand the various aspects of an information retrieval system and its evaluation and to be able to design such systems from scratch.

Course outcomes:

After successful completion of this course the student will be able to:

1. Process Boolean queries using inverted indexes
2. Process queries in the document collection being searched
3. Understand techniques for compressing dictionaries
4. Evaluate Information retrieval systems
5. Use enhanced retrieval techniques

COURSE CONTENT

Information Retrieval		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Boolean retrieval: An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval,

The term vocabulary and postings lists: Document delineation and character sequence decoding,

Determining the vocabulary of terms: Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, Faster postings list intersection via skip pointers, Positional postings and phrase queries

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction: Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction **Index construction:** Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes		

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression, Variable byte codes, Gamma codes **Scoring, term weighting and the vector space model:** Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, Variant tf-idf functions		

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Tiered indexes, Query-term proximity, Designing parsing and scoring functions, Putting it all together, Vector space scoring and query operator interaction, **Evaluation in information retrieval:** Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance, Critiques and justifications of the concept of relevance, A broader perspective: System quality and user utility		

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, The Rocchio algorithm for relevance feedback, Probabilistic relevance feedback, When does relevance feedback work?, Relevance feedback on the web, Evaluation of relevance feedback strategies, Pseudo relevance feedback, Indirect relevance feedback, Global methods for query reformulation, Vocabulary tools for query reformulation, Query expansion, Automatic thesaurus generation **Probabilistic information retrieval:** Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model, An appraisal of probabilistic models, Tree-structured dependencies between terms, Okapi BM25: a non-binary model, Bayesian network approaches to IR		

Text Books:

1. C. D. Manning, P. Raghavan, and H. Schutze, An Introduction to Information Retrieval, Cambridge University Press, 2009.

Reference Books:

1. R. Baeza-Yates and B. Ribeiro-Neto, Modern Information Retrieval, Pearson Education, 1999.

Ethical Practices in Business (Open Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Ethical Practices in Business**	**Short Title:**	**EPB**	**Course Code:**	
Course description:					
This course introduces Business ethics as the modern managerial approach to ethical questions in business environment. It gives not only understanding of main theoretical concepts, but also developing skills of identification, analysis and permission of ethical dilemmas on a workplace and managing ethics in organizations.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):
Course objectives:
1. To know the Business Ethics. 2. To understand ethical decision making in Business. 3. To gain knowledge about Corporate Ethics. 4. To know the Corporate Social Responsibility. 5. To understand the Environmental Ethics.
Course outcomes:
After successful completion of this course the student will be able to:
1. Explain need for business ethics. 2. Apply the concept of decision making in Business. 3. Analyze different issues in Corporate Governance, strategies and techniques. 4. Describe Corporate Social Responsibility. 5. Solve issues related to environmental ethics.
COURSE CONTENT

Ethical Practices in Business		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to Business Ethics: Introduction, Principles of Personal Ethics, Principles of Professional Ethics, Business Ethics, Code of Conduct and Ethics for Managers, Importance and Need for Business Ethics, Characteristics of An Ethical Organization, Ethical Theories in Relation to Business, Principles of Justice. Ethical Dilemmas: Introduction, Sources of Ethical Problems, How to Resolve an Ethical Problem, How to Resolve an Ethical Dilemmas.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Business Ethics: Introduction, Ethical Decision Making in Business with Cross-Holder Conflicts and Competition, Applying Moral Philosophy to Ethical Decision Making, Ethical Decision Making in Business, Cognitive Moral Development, Kohlberg's Model of Cognitive Moral Development, Influences on Ethical Decision Making.
Globalization and Business Ethics: Growth of Global Corporation, Factors Facilitating Globalization, Role of Multinational Corporation, International Business Issues, Benefits of MNC's to the Host Nation, Disadvantages of MNC's to the Host Country, Creating of an Ethical Organization:

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Corporate Ethics: Introduction to Corporate Governance, Significance of Corporate Governance to Developing Countries, Issues in Corporate Governance, Strategies, Techniques, and benefits to Corporate Governance, Indian Model of Corporate Governance, Good Governance, Obligations, Ethical Governance Needed to Protect Stakeholders, Long Term Shareholder value, Right's of Share Holders, Investor Protection in India, Problems of Investor in India.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Corporate Social Responsibility: Introduction to CSR, Models for Implementation of CSR, Advantage and Scope of CSR, Steps to Attain CSR, External Standards on CSR, Prestigious Awards for CSR.
Ethics of Consumer Protection: Consumer-An Important Stakeholder, Stakeholder Alliance, Consumer Protection, Consumer Duties, Consumer Protection In India.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Environmental Ethics: Environmental Concerns, History, Philosophy, Theories of Environmental Ethics, International Issues, Sustainable Development, Cost and Benefits of Environmental Regulation, Industrial Pollution, Role of Corporation In Environmental Management, Waste Management and Pollution Control, Managing Environmental Issues, Environmental Risk Management, Environment Management in India.

Text Books:

1. A. C. Fernando, K. P. Muraleedharan, E. K. Satheesh, "Business Ethics An Indian Perspective", Third Edition, Pearson.

Reference Books:

1. Manuel G. Velasquez, "Business Ethics Concept and Cases", Seventh Edition, Pearson.
2. B. N. Ghosh, "Business Ethics and Corporate Governance", Tata McGraw Hill.
3. John R. Boatright, Jeffrey D. Smith, Bibhu Prasan Patra, "Ethics and The Conduct of Business", Eight Edition, Pearson.

Total Quality Management (Open Elective Course – IV)

COURSEOUTLINE

Course Title:	**Total Quality Management**	**Short Title:**	**TQM**	**Course Code:**	

Course Description:

This course exposes participants to contemporary knowledge and techniques of TQM. This would in turn enable the participant to articulate and implement quality improvement processing the workplace, in line with the philosophy of Total Quality Management.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Course Objectives:

To give the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Understand the philosophies--including similarities and differences--of the gurus of TQM in order to better evaluate TQM implementation proposals offered by quality management organiza-tions and consultants.
3. Utilize Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation.
4. Apply various quality improvement techniques.
5. Successfully implement process improvement teams trained to use the various quality tools for identifying appropriate process improvements & assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard.

COURSE CONTENT

Total Quality Management		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**

	Internal Sessional Exams (ISE):	40 marks

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**
Introduction to Quality Management: Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Principles & Philosophies of Quality Management: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Statistical Process Control & Process Capability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Tools & Techniques for Quality Management: Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Quality Systems organizing & Implementation: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.		

Text Books:

1.Janakiraman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.

Ltd., 2006. 3. RamasamySubburaj, "Total Quality Management", Mc Graw Hill, New Delhi.
Reference Books:
1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education, (First Indian Reprints 2004). 2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002. 3. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012. 4. ISO 9001-2015 standards

Logical Reasoning and Problem Solving (Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Logical Reasoning and Problem Solving**	**Short Title:**	**LRPS**	**Course Code:**	

Course description:

This course enables students to develop their ability to reason by introducing them to elements of formal reasoning. The primary focus will be on recognizing the logical structure of arguments. Topics will include types of statements, symbolism, logical connectives, logical relations, basic deductive inferences, truth tables, validity, invalidity, and soundness; and may include, in addition, inductive reasoning.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Course objectives:

1. Course will provide an introduction to logical and philosophical reasoning.
2. Acquires, analyzes, and evaluates information from multiple sources.
3. Reflects on experiences with diversity to demonstrate knowledge and sensitivity.

Course outcomes:

After successful completion of this course the student will be able to:

1. Tell Analogy, Classification, perform coding and decoding on data
2. Recognize logical and philosophical reasoning.
3. Recognize logical reasoning applicable to real-life situations, solve real-life problems
4. Experience with diversity to demonstrate knowledge and sensitivity.
5. Solve application problems involving Clock, Calendar and Ratio and Proportion.

COURSE CONTENT

Logical Reasoning and Problem Solving		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Analogy : Completing the analogous pair, Direct/ Simple Analogy, Choosing the analogous pair, Double Analogy Choosing a similar word, Detecting Analogies, Multiple word analogy, Number analogy, Alphabet Analogy

Classification : Choosing the odd word, Choosing the odd pair of word, Choosing the odd numeral, Choosing the odd numeral pair/ group

Coding and Decoding : Letter coding, Direst letter coding, Number/ Symbol Coding, Matrix Coding , Substitution, Deciphering message word codes, Deciphering number and symbol codes for messages.

Blood relations: Deciphering jumbled up descriptions, Relation puzzle, Coded relations		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Direction sense Test : Directions and Cardinal Directions , Direction puzzle **Logical Sequence of words :** Sequence in process , Sequence in object formation **Data Sufficiency** : Yes/No Questions, Value Questions **Verification of Truth of the Statement:** Relationship with the thing mentioned.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Logic : Logical Reasoning, Logical Deduction , Two- Premise Arguments, Three- Premise Arguments **Statement – Arguments :** Strong arguments and weak Arguments **Statement –assumption :** Type 1- implicit statement, Type2-Implicit in Context **Statement –Conclusions :** Direct / indirect implications of conclusions		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Mirror-Images : Mirror-Images of Capital letters, Small letters, Numbers and figures **Water-Images :** Water-Images of Capital letters, Small letters, Numbers and figures **Cubes and Dice :** 2D and 3D cubes, Number opened dice and Letter opened dice		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Clocks : Finding Angle Between Minute And Hour Hands, Finding Time If Angle Is Given, Correct Time On Incorrect (Fast or Slow) Clocks. **Calendar:** Odd day, Leap year, Ordinary Year, Counting of Odd days, Day of the week related to odd days. **Ratio and Proportion :** Combined Ratio Based On Individual Ratios, Distributing Any Quantity Based On Ratios, Coins Based Ratio Problems, Mixtures & Replacement Based Ratio Problems **Alligation and mixture**: Allegation, mean price, Rule of Allegation		
Text Books:		
1. Dr. R.S. Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning" S. Chand Publication 2. Dr. R.S. Aggarwal "Quantitative Aptitude" S. Chand Publication, Revised Edition 2017		

Robotics (Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Robotics**	**Short Title:**	**RO**	**Course Code:**	

Course description:

In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Course objectives:

1. To understand structures and classifications in robotics
2. To gain knowledge of types of actuators and sensors in robotics.
3. To understand and learn robotic transformations.
4. To know different analysis techniques for robotic kinematics and dynamics.
5. To learn control techniques for robotic programming.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain structure and classification of robots.
2. Define role of actuators, sensors and vision system in robotics
3. Describe various transformations in robots.
4. Analyze the different kinematics and dynamics in robots.
5. Apply control techniques for programming in robotics

COURSE CONTENT

Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Robotics:

Robots, History of Robots, Robots Usage, Basic Structure of Robots, Classification of Robots by Applications, classification by Coordinate Systems, Classification by Actuation System, Classification by Control System, Robot classification by programming method.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Robot Actuators, Sensors and Vision:
Robot Actuators: Pneumatic , Hydraulic and Electric
Robot Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection
Vision System in Robots.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Transformations and Statics in Robotics:
Robot Architecture, Pose of Rigid Body, Coordinate Transformation, Denavit and Hartenberg(DH) Parameters
Forces and Moment balance, Recursive Calculations, Equivalent Joint Torque, Role of Jocobian in Statics.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Kinematics and Dynamics
Forward Position Analysis, Inverse Position Analysis, Velocity Analysis, Inerita Properties, Eular- Lagrange Formulation, Newton – Eular Formulation, Recursive Newton – Eular Algorithm

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Robotic Control and Programming:
Control Techniques, Second Order Linear Systems, Feedback Control and its Performance, Non Linear Trajectory Control, State Space Representation and Control, Stability, Cartesian and Force Controls, Robotic Programming

Text Books:

1. Saha, S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference Books:

1. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, PHI, New Delhi.
2. Mittal R.K. and Nagrath I.J., “Robotics and Control”, Tata McGraw Hill.
3. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi.
4. Craig, J.J., “Introduction to Robotics: Mechanics and Control”, Pearson, New Delhi, 2009.
5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modelling and Control”, John Wiley and Sons Inc, 2005.
6. Steve Heath, “Embedded System Design”, 2nd Edition, Newnes, Burlington, 2003.

Cyber Security Lab

LAB COURSE OUTLINE

Course Title:	**Cyber Security Lab**	**Short Title:**	**CSL**	**Course Code:**	

Course description:

Cyber Security Lab course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Computer Network

Course objectives:

1. To learn Information Technology Act of India.
2. To understand the importance of Cyber Security.
3. To learn Offensive Cyber Security Tools.
4. To learn Defensive Cyber Security Tools.
5. To learn Security Testing Tools for Web Applications.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. To describe Information Technology Act of India.
2. Describe Cyber Security.
3. Demonstrate Offensive Cyber Security Tools.
4. Demonstrate Defensive Cyber Security Tools.
5. Demonstrate Security Testing Tools for Web Applications.

LAB COURSE CONTENT

Cyber Security Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End Semester Exam (ESE): OR**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

1. Study of Information Technology Act – Indian Perspective.
2. Study of recent Cyber Incidents / Vulnerability.
3. Concerned faculty member should suitably frame Four Laboratory assignments with hands-on based on following tools but not limited to:
    - Security Testing Tools for Web Applications
        - Tools to Scan Website Security Vulnerabilities & Malware
        - Security tools for online protection
        - Check if your password is strong

    - Social Media Security
    - Safe Browsing
    - Backup
    - Reporting to government organizations or cyber security companies
- Networking & Security Auditing Tools
    - Offensive Cyber Security Tools
    - Breach Discovery
    - Internet Security
    - Email Security
    - Cyber Security Frameworks & Operating Systems
    - Vulnerability Scanning Tools
    - Password Management, Recovery & Attack Tools
- Defensive Cyber Security Tools
    - Open source firewall
    - Security Information and Event Management (SIEM) solution
    - Open Source Intelligence (OSINT) Tools
- Open Web Application Security Project (OWASP)

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

References:

1. Awesome Security, https://github.com/sbilly/awesome-security
2. Open Web Application Security Project (OWASP), https://owasp.org/
3. Indian Computer Emergency Response Team, https://www.cert-in.org.in/
4. Kali Linux Tools Listing, https://tools.kali.org/tools-listing
5. National Cyber Crime Reporting Portal, https://cybercrime.gov.in/

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal.

In the ESE (OR), the students may be asked oral questions to judge depth of understanding.

Advanced Technology Lab - II					
LAB COURSE OUTLINE					
Course Title:	**Advanced Technology Lab - II**	**Short Title:**	**ATL - II**	**Course Code:**	
Course description:					
The course focuses on practical hands-on of recent technologies.					

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**2**	**14**	**28**	**3**
Laboratory	**2**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Programming Language
Database Management Systems
Computer Network

Course objectives:

To enhance competency by undertaking laboratory assignments using Full Stack.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Break down real world problems / application.
2. Demonstrate Full Stack development.
3. Design Full Stack based applications.
4. Decide tools for Full Stack development.
5. Develop Full Stack based applications.

LAB COURSE CONTENT			
Advanced Technology Lab - II		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Theory:	**2 hours/week**	**End Semester Exam (ESE): (PR)**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Concerned faculty member should suitably frame Three Laboratory assignments using Full Stack (Front End, Back End and Database) by considering the technological aspects, utility and recent trends. The assignments should be based on real world problems / application, other than performed in Advanced Technology Lab - I. The assignments and / or tools in the Full Stack may be framed per individual student or group of students. The assignments may also be based on professional elective course opted by individual student or group of students in the current semester, but must be based on real world problems / application. For better understanding of various facets of different Full Stacks, it is expected that the assignments should be implemented using more than one Full Stacks.

Following are the suggested list of tools but not limited to:

Operating System
- 64-bit Open source Linux or its derivative or Windows

Programming Languages: C++ / C# / JAVA / PYTHON / R

Programming tools:
- Front End: Java / Perl / PHP / Python / Ruby / .NET / HTML / Wordpress / Drupal / Javascript / JQuery / Laravel Blade / MeteorJS / AngularJS / ReactJS / VueJS etc.
- Backend: C / C++ / Java / Java Spring / Java Swing / Node JS / Ruby / Python / .NET / PHP/ Laravel etc.
- Database: MongoDB / MYSQL / Oracle / SQL Server, Database Connectivity: ODBC / JDBC etc.

Some of the Full Stack:
- LAMP / WAMP stack: JavaScript - Linux - Apache - MySQL - PHP
- LEMP / WEMP stack: JavaScript - Linux - Nginx - MySQL - PHP
- MEAN stack: JavaScript - MongoDB - Express - AngularJS - Node.js
- Django stack: JavaScript - Python - Django - MySQL
- Ruby on Rails: JavaScript - Ruby - SQLite - Rails

For each laboratory assignment, Software Engineering approach with proper documentation is required.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

Reference Books:

Online web Resources

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

<table>
<tr><td colspan="6" align="center">Project</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Project</td><td>Short Title:</td><td>PROJ</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.</td></tr>
</table>

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	6	14	84	3

<table>
<tr><td>End Semester Exam (ESE) Pattern:</td><td>Oral (OR)</td></tr>
<tr><td colspan="2">Prerequisite course(s):</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Course objectives:</td></tr>
<tr><td colspan="2">1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Course outcomes:</td></tr>
<tr><td colspan="2">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="2">1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

<table>
<tr><td colspan="4" align="center">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Project</td><td>Semester:</td><td align="center">VIII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme:</td></tr>
<tr><td rowspan="2">Practical:</td><td rowspan="2">6 hours/week</td><td>End semester exam (ESE): (OR)</td><td>50 marks</td></tr>
<tr><td>Internal Continuous Assessment (ICA):</td><td>50 marks</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for</td></tr>
</table>

the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the complete project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)
- Summary

Chapter 4. Design

- System Arch
- Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Coding/Implementation

- Algorithm/Steps
- Software and Hardware for development in detail
- Modules in Project

Chapter 6. Testing

- Black Box/White Box testing
- Manual/Automated Testing
- Test Cases Identification and Execution (Test case ID, Input, Output, Expected Output, Actual Output, Result (Pass/Fail) etc.)

Chapter 7. Results and Discussion

Chapter 8. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for
Final Year Electrical Engineering

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

Syllabus Structure
Semester - VII and VIII
w. e. f. 2021 – 22

Syllabus Structure for Final Year Engineering (Semester – VII) (Electrical) (w.e.f. 2021 – 22) (As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Electrical Drives	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Electrical Drives Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
MATLAB and its applications	D	1	-	2	3	-	-	25	25(OR)	50	2
Project (Stage -I)	G	-	-	12	12	-	-	50	50(OR)	100	6
Essence of Indian Traditional Knowledge	H	-	-	-	-	-	-	-	-	-	-
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Electrical Energy Conservation and Auditing	1	Power System Dynamics and Control	1	VLSI Design and Technology
2	Electrical Machines Modelling and Analysis	2	Power Electronics and Distributed Generation	2	Artificial Intelligence
3	Power Generation and Economics	3	Industrial Electrical Systems	3	Virtual Reality
4	Digital Control System	4	Power System Design Practice	4	Bio-Medical Instrumentation

Syllabus Structure for Final Year Engineering (Semester – VIII) (Electrical) (w.e.f. 2021 – 22) (As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Power System Protection	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course - V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course - IV	F	3	-	-	3	40	60	-	-	100	3
Power System Protection Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
High Voltage Laboratory	D	2	-	2	4	-	-	25	25(OR)	50	3
Project	G		-	6	6	-	-	50	50(OR)	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V		**Professional Elective Course – VI**		**Open Elective Course – IV**	
1	Flexible AC Transmission System & Power Quality	1	Electric and Hybrid Vehicles	1	Digital Signal Processing
2	Power Converter Applications	2	Advanced Electric Drives	2	Embedded System
3	HVDC Transmission Systems	3	EHVAC Transmission Systems	3	Robotics
4	Power System Restructuring	4	Illumination Engineering	4	Cyber Security

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Electrical Engineering

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester – VII

w. e. f. 2021 – 22

Electrical Drives

COURSE OUTLINE

Course Title:	**Electrical Drives**	**Short Title:**	**ED**	**Course Code:**	

Course description:

The course aims to give a broad view of Electrical Drive System. It is considered that students have prior knowledge of Electrical Machines and Power Electronics. The control principles for AC and DC motors fed converters are discussed. Principles of selection for AC DC motors are also discussed. Some of the applications related to AC and DC drives are also highlighted.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	**14**	**42**	**03**

Prerequisite course(s):

Electrical Machines, Control Systems, Power Electronics

Course objectives:

The main objective of the course is to: Analyze most of the widely used converters for ac and dc motors, Understand performance of converter fed AC and DC motors and its speed torque characteristics and learn various control methods for ac and dc drive.

Course outcomes:

After successful completion of this course the student will be able to:

1. Select a drive for a particular application based on power rating.
2. Select a drive based on mechanical characteristics for a particular drive application.
3. Operate and maintain solid state drives for speed control of DC and AC machines.
4. Operate and maintain solid state drives for speed control of various special electrical machines
5. Identify and select AC drives for different applications.

COURSE CONTENT

Electrical Drives		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Fundamentals of Electric Drive: Electric Drives and its parts, advantages of electric drives Classification of electric drives Speed-torque conventions and multi-quadrant operations Constant torque and constant power operation Types of load torque: components, nature and classification.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Dynamics of Electric Drive: Dynamics of motor-load combination Steady state stability of Electric Drive Transient stability of electric Drive Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Electric Braking: Purpose and types of electric braking, braking of DC, three phase induction and synchronous motors Dynamics during Starting and Braking: Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.		

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Power Electronic Control of DC Drives: Single phase and three phase-controlled converter fed separately excited DC motor drives (continuous conduction only), dual converter fed separately excited DC motor drive, rectifier control of DC series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited DC motor and DC series motor.		

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Power Electronic Control of AC Drives: Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cycloconverter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self-controlled scheme Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for applications.		

Textbooks:

1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House, 2nd edition, 2002.
2. S.K. Pillai, “A First Course on Electric Drives”, New Age International Publishers, 3rd edition, 2012.
3. B.N. Sarkar, “Fundamental of Industrial Drives”, Prentice Hall of India Ltd., 2012.

Reference Books:

1. M. Chilkin, “Electric Drives”, Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore, 2nd edition, 2017.
3. N. K. De, Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd., 2014.
4. V. Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill, 1994.

Electrical Energy Conservation and Auditing (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Electrical Energy Conservation and Auditing**	**Short Title:**	**EECA**	**Course Code:**	

Course description: The course explores the knowledge of current energy Scenario, sources of primary energy and Scope of conservation in view of environment and climate change. This course provides knowledge of limited conventional energy generation, energy audit and conservation, Energy Conservation Act, energy efficient motors and other electrical gazed, scope of energy saving in domestic, industrial, agricultures sectors and demand side managements .Energy conservation is mandatory and answerable to next generation.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives: The Objectives of subject are to understand the need of energy audit and conservation, social and environmental cause as per Energy conservation Act. Students will be able to know the methodology of energy audit for industries and priority of action plan Students will be able to understand scope demand side management, energy efficient motor and energy conservation in motors, lighting and refrigeration. Students will be able to do energy performance assessment of electrical installation and understand the financial analysis for energy audit like payback period.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the current energy scenario and importance of energy conservation in view of social and environmental cause.
2. Apply basic knowledge of engineering to understand need of energy audit, identify methods, and analyze technical and economic feasibility. Also, able to summarize all possible suggestion for fruitful results.
3. Identify methods for energy management by IT tools including prediction and modeling to complex engineering problems, analyze the energy data and electric tariff for implementation of demand side management in every sector of consumer.
4. Investigate the consumption in motive, illumination, heating, and cooling system for conserving electrical energy by professional and ethical way and able to solve complex engineering problems.
5. Apply appropriate techniques, resources, for analyzing performance assessment of motors. Cooling system, pumps and lighting system. Students also able to recognize the importance of financial analysis.

Electrical Energy Conservation and Auditing

COURSE CONTENT

Electrical Energy Conservation and Auditing		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**

	Duration of ESE:	**03 hours**
	Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Energy Scenario and Scope of conservation: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, energy strategy for the future, Energy Conservation Act-2001 and its features. Progress made in energy conservation in India. Scope of energy conservation in different sectors

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Energy Audit: Principles of energy audit, type and methodology of energy audit: preliminary energy audit and detailed energy audit, procedures of carrying out energy audit, energy audit implementation priority, understanding energy cost, bench marking energy performance, fuel and energy substitution, energy audit report writing, instruments used for energy audit.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Energy Management: Concept of energy management, review of load and utilization factors, bench marking, fuel and energy substitution, power factor improvement, power demand monitoring. Impact of electric tariff on energy management. Billing methods Concept of demand side management (DSM), scope of DSM, Load control methods, DSM planning and implementation, load management as DSM strategy Advantages of DSM to consumers, utility, and society.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Energy Efficiency and Conservation: Motive power: potential for saving electrical energy in motors - over sizing or under loading, improving efficiency of an existing motor, energy efficient motor, use of variable or adjustable speed drives for energy conservation, effect of rewinding on performance and consumption. Transformer losses, energy efficient transformer and energy efficiency rating. Lighting: level of illumination for different areas. Use of right source of lamp for different applications, energy efficient lamps, energy conservation scope in lighting system Energy efficiency in air conditioning, control strategies and energy conservation opportunities

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Performance Assessment: Energy performance assessment of variable speed drives, performance terms, points for user, testing performance evolutions, format for data collection. Energy performance assessment of refrigeration and air conditioning system, performance terms, performance evolutions. Energy performance assessment of water pumps. Energy performance assessment of lighting system. Financial analysis.

Textbooks:

1. Umesh Rathore, “Energy Management”, S. K. Kataria and Sons, 2nd Edition, 2014.
2. S. C. Tripathy, “Electrical Energy Utilization and Conservation”, Tata McGraw-Hill, 1991.

Reference Books:

1. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects (online).
2. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book-3, Electrical Utilities (online)
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
4. B. E. Kushare, "Handbook on Energy Efficient Motors", International Cooper Proposition Council.

Electrical Machines Modelling and Analysis (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Electrical Machines Modelling and Analysis**	**Short Title:**	**EMMA**	**Course Code:**	

Course description:

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Electrical Machines-I and II

Course objectives:

The objective of this course is to provide the students In-depth understanding of generalized machine theory which forms the basis of Machine modelling. Explore the concept of transformation of variables to develop mathematical model of machines. It provides good initiation to develop Mathematical modelling and analysis. The concepts & techniques of Speed control of electrical machines which are essential for high performance drives. An in-depth exposure to the various equivalent circuits and their application to performance analysis of Electrical Machines.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain generalized theory of electrical machines
2. Apply linear transformations to Electrical machines.
3. Develop mathematical models of DC machines and its analysis under normal and perturbation.
4. Develop mathematical models of synchronous machines and its analysis under normal and perturbation.
5. Develop mathematical models of induction machines and its analysis under normal and perturbation.

COURSE CONTENT

Electrical Machines Modelling and Analysis		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Basic Principles of Electrical Machine Analysis: Magnetically Coupled Circuits, Electromechanical Energy Conversion, Machine Windings and Airgap MMF, Winding Inductances and Voltage equations, basic two pole machine, per unit system, transformer with movable secondary, analysis of electrical machine.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Linear Transformation in Machines: Invariance of Power, transformation from a displaced brush axis, transformation from three phase to phase, transformation from rotating axis to stationary axis, physical

concept of Park's transformation, apply generalized theory to electrical machines.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Modelling and Analysis of DC Machines: Separately excited dc generator and motor, interconnection of machines, transfer function of dc machine (DC Series and DC Shunt), linearization techniques for small perturbation and electrical braking of DC motor.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Modelling and Analysis of Synchronous Machine: Basic synchronous machine parameters, general machine equations, balance steady state analysis, steady state power angle analysis, short circuit ratio, transient analysis, transient analysis a qualitative approach, transient reactance and time constant from equivalent circuit, transient power angle characteristics.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Modelling and Analysis of polyphone Induction Machine: Electrical performance equations, analysis of equivalent circuit, torque slip characteristic, effect of voltage and frequency variation on performance, operation under unbalance, effect of space harmonics on performance and analysis.		
Textbooks:		
1. P.S. Bimbhra, "The Generalised Theory of Electrical Machines", Khanna Publishers, 6th Edition, 2011.		
Reference Books:		
1. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 6th Edition, 2013. 2. E. Clayton, N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 3rd Edition, 2004. 3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 3rd Edition, 2002. 4. J. Nagrath, D. P. Kothari, "Electric Machines", McGraw Hill Education, 4th Edition, 2010. 5. P.C. Krause, "Analysis of Electric Machinery", McGraw Hill, NY, 3rd Edition, 1987 6. C.V. Jones, "The unified Theory of Electrical Machines", Butterworth-London, 1967 7. Dhar R.N., "Computer Aided Power System Operation and Analysis", Tata McGraw Hill		

Power Generation and Economics (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Power Generation and Economics**	**Short Title:**	**PGE**	**Course Code:**	

Course description:

This course introduces power generation by using conventional sources. This course covers the working, selection of site, different elements of various conventional power plants. This course also introduces the economics consideration of the power plants.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power System-I, Power System-II

Course objectives:

The objectives of this subject are that students will be able to be understanding the working, selection of site, different elements, and general arrangement of Hydro Power plants, Thermal Power plants and Nuclear power plants. The objectives of this subject are that students will be able to understand cost analysis, effects of various loads on power system, load sharing. Choice of size and number of generating plants. The students will be able to understand effect of power factor on power system and methods to improve power factor.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the arrangement and operation of hydroelectric power plant.
2. Explain the arrangement and working of Thermal Power plants.
3. Explain the arrangement and working of Nuclear Power plant.
4. Define cost analysis of power plants.
5. Define effects of power factor on power system and methods for improving the power factor.

COURSE CONTENT

Power Generation and Economics		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Hydroelectric Power Plant: Hydrology, run off and stream flow, hydrograph, flow duration curve, Mass curve, reservoir capacity, dam storage. Hydrological cycle, merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, elements of the plant, Classification of the plants based on water flow regulation, water head and type of load the plant must supply. Water turbines– Pelton wheel, Francis, Kaplan, and propeller turbines. Characteristic of water turbines Governing of turbines, selection of water turbines. Underground, small hydro and pumped storage plants. Choice of size and number of units, plant layout and auxiliaries.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Thermal Power Plant: Introduction, Efficiency of steam plants, Merits and demerits of plants, selection of site. Working of steam plant, Power plant equipment and layout, Steam turbines, Fuels and fuel handling, Fuel combustion and combustion equipment, Coal burners, Fluidized bed combustion, Combustion control, Ash handling, Dust collection, Draught systems, Feed water, Steam power plant controls, plant auxiliaries.

Diesel Power Plant: Introduction, Merits and demerits, selection site, elements of diesel power plant, applications.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Nuclear Power Plants: Introduction, Economics of nuclear plants, Merits and demerits, selection of site, Nuclear reaction, Nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Classification of reactors, power reactors in use, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Economics Considerations I: Introduction, classification of costs, Cost analysis of power plants. Interest and Depreciation, Methods of determination of depreciation- Diminishing Value or Declining method, sinking fund method, Economics of Power generation, Effect of variable load on power system, different terms considered for power plants and their significance, load sharing. Choice of size and number of generating plants and numerical.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Economics Considerations II: Tariffs, objective, factors affecting the tariff, types. Types of consumers and their tariff. Power factor, disadvantages of low power factor, causes of low power factor, methods of power factor improvement, Location of Power factor correction equipment, Advantages of power factor improvement, economics of power factor improvement and comparison of methods of increasing power supplied, Choice of equipment.

Textbooks:

1. B.R. Gupta, "Generation of Electrical Energy", Eurasia Publishing House (Pvt.) Ltd, Seventh Edition, 2017.
2. J.B. Gupta, "A Course in Electric Power", S.K. Kataria and Sons, Fourteenth Edition, 2013.

Reference Books:

1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.
2. D.P. Kothari, I.J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill Education, Fourth Edition, 2011.
3. William D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 4th Edition, 1985.

4. Leon K. Kirchmayer, “Economic Operation of Power Systems”, Wiley India Pvt. Ltd, 2009.
5. C. L. Wadhwa, “Electrical Power System Analysis”, New Age International Publication, Seventh Edition, 2017.
6. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill, 2nd Edition, 2009.
7. A. Chakrabarti, M.L. Soni, P.V. Gupta & U.S. Bhatnagar, “A Textbook on Power System Engineering”, Dhanpat Rai & Co. limited, 2016.
8. S. N. Singh, “Electric Power Generation: Transmission and Distribution”, PHI Learning, 2nd Edition, 2008.
9. Tanmoy Deb, “Electrical Power Generation”, Khanna Publishing House, 1st Edition, 2018.
10. http://nptel.iitm.ac.in

Digital Control System (Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Digital Control System**	**Short Title:**	**DCS**	**Course Code:**	

Course description:

Digital control is a branch of control theory that uses digital computers as system controllers. This course provides the knowledge about the basic signals, state space analysis, different methods used for stability analysis. This course designed to introduce to the student's basic design and Applications of Digital Control System.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Signals and systems, control system.

Course objectives:

Digital controllers are used in a wide variety of systems ranging from disk drives to aircrafts. Thus, it is especially important to be well-versed in the analysis and design of digital control systems. The course objectives include equipping students with:

1. Understanding the various issues related to digital control systems such as effects of discrete time signals and models,
2. Design and implementation of digital controllers. The digital controllers will also consider the practical implementation issues like aliasing and quantization to achieve the desired performance specifications.

Course outcomes:

After successful completion of this course the student will be able to:

1. To make students understand basic concepts of discrete signals and systems.
2. To understand the concept of state and to be able to represent a system in the state space format and to solve the state equation and familiarize with STM and its properties.
3. To educate students to analyze the stability of digital systems.
4. To be able to analyze and design a digital control system including realization of digital controllers.
5. To explore application of the theory of digital control to practical problems.

COURSE CONTENT

Digital Control System		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Discrete systems and Signals Standard discrete test signals, Basic operations on signals, Classification of discrete systems, Detail analysis of frequency aliasing & quantization, Brief review of Sampling theorem, Z-transform, Laplace transform and Fourier transform, Transfer function of ZOH, Frequency domain characteristics of ZOH.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

State - Space analysis: Solution of LTI Discrete –time state equation, State Transition Matrix (STM) and properties of STM, Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Stability Analysis: Pulse transfer function, Mapping between S-plane and Z-plane, Stability analysis of closed loop system in the Z-Plane, Jury's stability test, Nyquist stability criteria, Lyapunov stability theorem, Stability analysis by use of Bilinear transformation & Routh-Hurwitz Stability Criterion, Digital compensator design using frequency response (Bode plot).

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Design of Digital Control System: Introduction to PID controller, individual effect of Proportional controller, Integral controller and Derivative controller on overall system performance, Concepts of Controllability and observability, Effect of pole- zero cancellation on controllability and observability of the system. Pole placement design by state variable feedback, Necessity of observer, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Applications of Digital Control System: Digital temperature control - first order temperature system, process model, design of PID controller, control law for temperature control. Position control-position control system, position control system using speed feedback.

Textbooks:

1. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th edition, 2015.
2. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2009.

Reference Books:

1. Astrom Karl Johan and Wittenmark Bjorn, "Computer-Controlled Systems: Theory and Design", Prentice-Hall, 3rd Edition, 2011.
2. M. Gopal, "Digital Control Engineering", New age international pvt. ltd, 2nd Edition, 2014.
3. Kuo B. C., "Automatic Control System", Prentice Hall, 7th edition, 2001.

<table>
<tr><td colspan="8">Power System Dynamics and Control (Professional Elective Course – IV)</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td colspan="2">Power System Dynamics and Control</td><td>Short Title:</td><td>PSDC</td><td>Course Code:</td><td colspan="2"></td></tr>
<tr><td colspan="8">Course description:</td></tr>
<tr><td colspan="8">Modern power systems have grown larger, expanding over wide geographical area. Interconnection of grids has led to more complex operational problems. Such large systems require very advance computing facilities and techniques. This course explores knowledge of economic load scheduling and dispatch. The course provides knowledge of power system operation and control, need and important, voltage and frequency control. The course also provides knowledge of steady state and transient stability of a power system.</td></tr>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td colspan="2">No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>03</td><td colspan="2">14</td><td colspan="2">42</td><td colspan="2">03</td></tr>
<tr><td colspan="8">Prerequisite course(s):</td></tr>
<tr><td colspan="8">Power System-I, Power System-II</td></tr>
<tr><td colspan="8">Course objectives:</td></tr>
<tr><td colspan="8">The objectives of this course are to study about the economic load dispatch and optimal operation of power system. In this course knowledge of Automatic voltage control, excitation systems, static performance, and dynamic response of AVR loops should be provided. The course objectives are to study about the Automatic load frequency control, Concept of control area. In this course we will try to understand how to assess the stability of a power system, how to improve the stability and finally how to prevent system becoming unstable.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course outcomes:</td></tr>
<tr><td colspan="8">After successful completion of this course the student will be able to:</td></tr>
<tr><td colspan="8">1. Know the optimal load scheduling, function & operation of load dispatch center for economic growth of electric utilities.
2. Know the concept of automatic voltage control, their mathematical modeling, static and dynamic analysis.
3. Know the concept of frequency control, mathematical modeling, static and dynamic response of single area system.
4. Describe steady state stability of a power system
5. Describe transient stability of a power system.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">COURSE CONTENT</td></tr>
<tr><td colspan="3">Power System Dynamics and Control</td><td colspan="2">Semester:</td><td colspan="3">VII</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="5">Examination scheme</td></tr>
<tr><td>Lectures:</td><td colspan="2">3 hours/week</td><td colspan="4">End Semester Exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="3" rowspan="2"></td><td colspan="4">Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="4">Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
</table>

Unit–I:	No. of Lectures: 08 Hours	Marks: 12
Economic Load Dispatch & Optimal Operation of Power System: Input Output characteristics, Heat-rate characteristics, Incremental fuel rate and cost, Incremental production cost, optimum scheduling of generation between different units. (Neglecting transmission losses), Transmission loss as a function of plant generation (A simple system connection two generating plants to load) and incremental transmission loss for optimum economy, Calculation of loss coefficients (Two plants system), Optimum scheduling of generation between different plants considering transmission loss concept and significance of penalty factor, Automatic load dispatch, function and applications.		

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Generator Voltage Control: Automatic voltage control, generator controllers, Cross coupling between P–f and Q–V control channel, automatic voltage regulator, types of exciters and excitation systems, exciter modeling, transfer function modeling for control static performance and dynamic response of AVR loops.		

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Load Frequency Control: Automatic load frequency control, speed governing system and hydraulic valve actuator for individual generator, Turbine modeling, generator and load modeling, transfer function representation of power control mechanism of generator. Load frequency of single areas power system with and without integral controls. Introduction to pool operation.		

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Introduction: Meaning of stability, types of stability, rotor angle of synchronous machines, voltage and frequency stability **Steady State Stability:** Steady state stability limit, Effects of losses on steady state stability, Effect of inertia on steady state stability, Effect of automatic voltage regulator, calculation of steady state stability limit, methods to improve SSSL.		

Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Transient Stability: Meaning of transient stability, Sudden short circuit on synchronous machine and reactance's. Assumptions made for swing equation, swing equation, shortcoming of classical model, Equal area criterion, Critical clearing angle and time, sudden short circuit on one of parallel transmission line, methods to improve transient stability.		

Textbooks:

1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.
2. E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.

Reference Books:

1. D. P. Kothari, I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill Education, Fourth Edition, 2011
2. William D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 4^{th} Edition, 1985.
3. C. L. Wadhwa, "Electrical Power System Analysis", New Age International Publication,

Seventh Edition, 2016

4. Dr. K. Uma Rao, “Power System Operation and Control”, Wiley India Pvt. Ltd., 2012.
5. Aderson and Ford, “Power System Control and Stability”, Wiley India Pvt. Ltd. Second Edition, 2008.
6. P. S. Bimbhra, “The Generalised Theory of Electrical Machines”, Khanna Publishers, 6th Edition, 2011.
7. Peter W. Sauer and M. A. Pai, Joe H. Chow “Power System Dynamics and Stability”, Wiley-IEEE Press, Second Edition, 2017.
8. http://nptel.iitm.ac.in

Power Electronics and Distributed Generation (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Power Electronics and Distributed Generation**	**Short Title:**	**PE&DG**	**Course Code:**	

Course description:

Introduction to distribution systems, distribution system equipment, grounding, sequence analysis and fault calculations, relaying requirements for Distributed Generation (DG) systems. Intentional and unintentional islanding, power converter topologies for grid interconnection, inverter modeling, filtering requirements. Selection of power converter components, DC bus designs, considerations for power loss and reliability in the design procedure, thermal cycling of power semiconductor modules, insulation grade selection, and thermal design implications. Control of grid interactive power converters, synchronization and phase locking techniques, current control, DC bus control, converter faults, grid parallel and standalone operation. Power quality, voltage unbalance, harmonics, flicker, voltage and frequency windows, and recent trends in power electronic DG interconnection.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Electric Power System, Power Electronics and Power System Protection

Course objectives:

1. Introduce the concept of distributed generation.
2. Investigate the technical challenges of Distributed Generation interconnection relaying and various power quality issues.
3. Analyze power converter design for the Distributed Generation.
4. Analyze the Semiconductor device selection in DG applications.
5. Investigate the various issues related to the protection, power quality, insulation ageing and filter designs for DG.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basics of distributed generation.
2. Analyze the use of different network distribution grids and impact of DG operation
3. Explain the use of Intentional and unintentional islanding systems for DG, their technologies and Control.
4. Interpret the performance analysis and lifetime estimation of power converters for DG.
5. Discharge professional duties in power industry with innovative ideas of operation and control of distributed generation.

COURSE CONTENT			
Power Electronics and Distributed Generation		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**

		Internal Sessional Exams (ISE):	**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**	
Distributed Generation (DG) - Overview and technology trends. Introduction to distribution systems. Radial distribution system protection: Fuse, circuit breakers, reclosers, sectionalizers. Per-unit analysis, fault analysis, sequence component analysis, sequence models of distribution system components. Implications of DG on distribution system protection coordination.			
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Power quality requirements and source switching using SCR based static switches. Distribution system loading, line drop model, series voltage regulators and online tap changers. Loop and secondary network distribution grids and impact of DG operation. Relaying and protection, distributed generation interconnection relaying, sensing using CTs and PTs.			
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Intentional and unintentional islanding of distribution systems. Passive and active detection of unintentional islands, non-detection zones. DG planning cost implications of power quality, cost of energy and net present value calculations and implications on power converter design. Power converter topologies and model and specifications for DG applications.			
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Capacitor selection, choice of DC bus voltage, current ripple, capacitor aging and lifetime calculations. Switching versus average model of the power converter and EMI considerations in DG applications. Semiconductor device selection, device aging due to thermal cycling, and lifetime calculations.			
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**	
Issues in output ac filter design, filter inductor selection. Insulation aging issues. Packaging issues in the power converter. Calculation of damage due to thermal cycles. Thermal impedance models. Control of DG inverters; phase locked loops, current control and DC voltage control for standalone and grid parallel operations. Protection of the converter. Complex transfer functions, VSI admittance model in DG applications. Power quality implication, acceptable ranges of voltage and frequency, flicker, reactive power compensation, and active filtering and low voltage ride through requirements.			
Textbooks:			
1. Math H. J. Bollen and Fainan Hassan, "Integration of Distributed Generation in the Power System", Wiley, 2018.			
Reference Books:			
1. Arthur R. Bergen, Vijay Vittal, "Power Systems Analysis", Pearson Education India, 2nd edition, 2009. 2. Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, Third Edition, 2014.			

Industrial Electrical Systems (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Industrial Electrical systems**	**Short Title:**	**IES**	**Course Code:**	
Course description:					
The subject explores the knowledge of Electrical System Components, Residential and Commercial Electrical Systems, Illumination Systems, Industrial Electrical Systems: HT connection, Industrial Electrical System Automation. Recognize the need for technical change & ability to learn in the broadest knowledge of Technical Advancement in Electrical System, Illumination, and other Applications.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Electrical Machines and mathematics

Course objectives:

To provide in-depth understanding of Electrical System Components, Residential and Commercial Electrical Systems, Industrial Electrical Systems: HT connection, industrial substation, Transformer selection, Role of Engineer in automation, advantages of process automation

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
2. Understand various terms regarding light, lumen, intensity, candle power, lamp efficiency, and specific consumption.
3. Understand various components of industrial electrical systems, Industrial loads, Switchgear selection
4. Analyze and select the proper size of Transformer.
5. Understand Role of in automation, PLC based control system design, Panel Metering

COURSE CONTENT

Industrial Electrical systems		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Electrical System Components: LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Illumination Systems: Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Industrial Electrical Systems: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Industrial Electrical System Automation: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering, and Introduction to SCADA system for distribution automation		

Textbooks:

1. S. L. Uppal, G. C. Garg, “Electrical Wiring, Estimating & costing”, Khanna publishers, 6th edition, 2008.

Reference Books:

1. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 1st edition, 2007.
2. S. Singh, R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 2nd edition, 2010.
3. J. B. Gupta, “Utilization of Electric Power & Electric Traction”, S.K. Kataria & Sons, 2nd edition, 2014.
4. H. Joshi, “Residential Commercial and Industrial Systems”, Volume I, McGraw Hill Education, 2008.

Power System Design Practice (Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Power System Design Practice**	**Short Title:**	**PSDP**	**Course Code:**	

Course description:

This course deals with design aspects of transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipment's along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	**12**	**42**	**3**

Prerequisite course(s):

Power System I, Power System II

Course objectives:

1. To educate students about the process of restructuring of power system
2. To familiarize students about the operation of power system
3. To teach students about designing concepts
4. To gain knowledge of fundamental concept of protection devices.
5. To analyze the terms required for tender filing.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze the aspects of designing various electrical systems
2. Model the distribution systems with complex technical constraints.
3. Identify different abnormal conditions and design protection system.
4. File the tenders for several power system sectors.
5. Classify different Earthing systems and design it.

COURSE CONTENT

Power System Design Practices		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**
Unit–I:		**No. of Lectures: 09 Hours**	**Marks: 12**

Design of Transmission System:

Selection of insulation parameters, selection of voltage level, choice of type of conductor, Design aspects of Transmission systems (GMD and GMR), Characteristic impedance and its significance, Radio interference and transposition.

Mechanical design of transmission line, Sag, Tension, wind effect and ice loading.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Design of Distribution System: Types of distribution system arrangements, Primary and secondary distribution design, calculation of distribution sizes: voltage drops, efficiency, voltage regulation, types of cables used, design of rural and industrial distribution systems.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design of Protection Systems: Operating mechanism, ratings and specifications, types of circuit breakers. Operating mechanism, ratings and specifications, types of Lightning Arrestors.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tenders Filing in Power System: Special characteristics to be defined in tender filing of Circuit Breakers, Lightning Arrestors, Transformers, Cables, Shunt Capacitors. Testing of Circuit Breakers, Lightning Arrestors, Shunt Capacitors.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Earthing Systems: Need of Earthing, various ways of Earthing according to voltage levels. Different Earthing done for transmission and distribution lines. Earthing Systems- step potential, touch potential, transfer potential.		
Textbooks:		
1. M. V. Deshpande, "Restructured Electrical Power System Design", Tata McGraw Hill, 2014. 2. B. R. Gupta, "Power System Analysis and Design" S Chand & Company, 2005.		
Reference Books:		
1. Pratapsing Satnam, P. V. Gupta, "Substation Design Equipment" Dhanpat Rai and Sons 2. K. B Raina and S. K. Bhattacharya, "Electrical Design-Estimation and Costing", New age international publishers, 2007.		

VLSI Design and Technology (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**VLSI Design and Technology**	**Short Title:**	**VLSIDT**	**Course Code:**	

Course description:

This course provides the basic knowledge necessary to understand how to simulate systems using hardware description languages. System here includes various digital logic circuits, such as adders, multiplexers, flip-flops, counters etc. VHDL is a hardware description language that can be used to model a digital system. It contains elements that can be used to describe the behavior or structure of the digital system. The language provides support for modeling the system hierarchically and supports top-down and bottom-up design methodologies.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

VLSI Design provides fundamental concepts in classical manual digital design, design entry using hardware description language. It emphasizes the HDL-based design because it is the most efficient design method to use in practice. This subject describes in detail the IEEE Standard VHDL language.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the modeling and design concepts of digital systems domains for different combinational and sequential circuits. Also understand the concepts of data-flow description in VHDL. Identify the signal assignment statement. Recognize the levels of modeling using VHDL.
2. Understand the concepts sequential statements and how differ from concurrent statement. Also identify the basic statement of behavioral description.
3. Understand the concepts of structural description, including the binding of modules.
4. Understand the concept of describing and simulating digital systems using transistors. Also identify the basic statements of switch-level package that matches the switch-level functions.
5. Understand the function of simulator, synthesizer and PLDs. Also, the concepts of states and their implementation.

COURSE CONTENT

VLSI Design and Technology		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction: History of HDL: Brief history of VHDL. Structure of VHDL module: Structure of Entity/

Module, Port. Operators in VHDL: Logical, Relational, Arithmetic Shift and Rotate Operators. Data types of VHDL. Types of Architectures. Simulation and Synthesis and comparison between them.
Data-flow Description (VHDL): Structure of Data-flow Description: Signal declaration and Signal assignment statements, Concurrent Signal assignment statements, Constant declaration and assignment statements, Assigning a delay to the signal assignment statements, VHDL Programming using Data-flow description.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Behavioral Description (VHDL): Structure of Behavioral Description for both VHDL. VHDL variable assignment statement. Sequential statements for VHDL: IF statement, Signal and variable (only for VHDL) assignment, Case statement, Loop statement. VHDL Programming using Behavioral description. Procedures and Functions (VHDL).

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Structural Description (VHDL): Organization of structural design, Binding, State machines, Generic (VHDL), VHDL Programming using Structural description.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Switch-Level Description (VHDL): Single NMOS and PMOS switches: NMOS and PMOS switch description for VHDL, Serial and parallel combinations of switches. Switch level description of: Primitive gates, Combinational logics, Sequential circuits. CMOS switch. Bidirectional switches. Mixed-Type description.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Finite state machine: Moore machine, Mealy machine, State diagram, State table, State Assignment.
Programmable Logic Devices: Architectures of Xilinx 9500 series CPLD, Xilinx Spartan 4000 series FPGA.
Testing of Logic Circuits: Fault model, path sensitizing, random test. Design of testability, BIST (Built-in-self-test), Boundary scan test.

Textbooks:

1. Nazeih M. Botros, "HDL programming Fundamentals VHDL and Verilog", Second Indian Edition, DA Vinci Engineering Press, Hingham, Massachusetts, 2011.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL design", McGraw Hill Education (India) Private Limited, New Delhi, Third Edition, 2012.
3. J. Bhaskar, "A VHDL Primer", Pearson, Third Edition, 2006.

Reference Books:

1. John F. Wakerly, "Digital Design, Principles and Practices", Pentice Hall Publication, 4th edition, 2007.
2. Douglas L. Perry, "VHDL: Programing by example", Tata MC-Graw Hill, New Delhi, Fourth Edition, 2005.
3. Volnei A. Pedroni, "Circuit Design with VHDL", Prentice-Hall of India Private Limited, New Delhi,

2nd edition, 2011.
4. Xilinx data manual, The Programmable Logic data Book.

Artificial Intelligence (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Artificial Intelligence**	**Short Title:**	**AI**	**Course Code:**	

Course description:

It is to introduce the students to the fundamentals of Artificial Intelligence, NLP and Neural Networks and enable them to apply these concepts for solving real world problems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To understand AI Problem and AI Techniques.
2. To learn heuristic search techniques in AI
3. To learn various ways to represent knowledge in AI
4. To understand planning and game playing strategies in AI
5. To understand basics of Neural Networks

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply AI techniques to solve different AI problems.
2. Apply appropriate search algorithms to solve AI problems.
3. Use different knowledge representational strategies to represent an AI problem.
4. Apply appropriate algorithm for game playing.
5. Understand the role of neural networks in AI.

COURSE CONTENT

Artificial Intelligence		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Artificial Intelligence:

Definitions of Artificial Intelligence, AI Problems, AI Techniques

Defining Problem as a State Space Search: 8 Queens Problem / 8 Puzzle Problem and its solution using production system, Water Jug problem and its solution using production system.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Heuristic Search in AI

Breadth First Search, Depth First Search

Best First Search: OR Graph, A* Algorithm

Problem Reduction: AND-OR Graph, AO* Algorithm

Unit–III	No. of Lectures: 08 Hours	Marks: 12

Knowledge Engineering:
Knowledge Representation Issues
Knowledge Representation Schemes: Logical Knowledge Representation, Procedural Knowledge Representation, Structural Knowledge Representation

Unit–IV	No. of Lectures: 08 Hours	Marks: 12

Planning and Game Playing:
Planning, Types of Planning
Goal Stack Planning: Overview, Block World Problem
Game Playing: Game Tree, Min Max Search Algorithm

Unit–V	No. of Lectures: 08 Hours	Marks: 12

Neural Networks:

Biological Neural Network, Artificial Neural Network, Difference between Biological and Artificial Neural Network, Types of Artificial Neural Network, Models of Neuron: McCulloch-Pitts Model, Perceptron, Adeline Topology

Textbooks:

1. Elaine Rich, Kevin Knight, Shivshankar Nair "Artificial Intelligence". 3rd Edition, TMH.
2. B. Yegnanarayana “Artificial Neural Networks”, PHI, 2006.

Reference Books:

1. S. Rajasekaran, G.A. Vijayalakshmi, “Neural Networks, Fuzzy Logic, and Genetic Algorithms”, PHI, 2013.
2. Timothy J Ross, “Fuzzy Logic with Engineering Application”, Wiley, 3rd edition, 2010,
3. Dan W. Patterson, “Introduction to artificial intelligence and expert system”, PHI, 1st edition, 2015.

Virtual Reality (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Virtual Reality**	**Short Title:**	**VR**	**Course Code:**	
Course description:					
Virtual Reality (VR) is the use of computer technology to create a simulated environment. In the simulated artificial environment, the user is able to explore the various artifacts and proceedings as they might in the real world.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To understand Virtual Reality and Virtual environment.
2. To know Different illumination models.
3. To understand Geometric Transformation
4. To Know about Virtual Hardware and Software
5. To learn Virtual Reality applications.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe Virtual Reality and Virtual environment.
2. Explain different illumination models.
3. Use Geometric Transformations for creation of various geometric objects
4. Explain Virtual Hardware and Software
5. Analyze Virtual Reality applications.

COURSE CONTENT

Virtual Reality		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark, 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image. Geometric Modeling: Introduction, From 2D to 3D, 3D boundary representation.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection. Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, VR Systems.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Animating the Virtual Environment: Introduction, The dynamics of numbers, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML.VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction.		
Textbooks:		
1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2011.		
Reference Books:		
1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000. 2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006. 3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2nd edition, 2018.		

Bio-Medical Instrumentation (Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Bio-Medical Instrumentation**	**Short Title:**	**BMI**	**Course Code:**	

Course description:

This course provides knowledge about biomedical instruments used in medical application medical recording and monitoring at patient monitoring system.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To introduce the electrical engineering students with biomedical measurement in patient monitoring system.
2. To understand operation of various electrical transducer for medical measurement
3. To study the patient Monitoring system and importance of Patient Safety related with electric shock hazards.
4. To understand principle and operation of instrument for blood pressure and cardiac measurement.
5. To study the modern imaging system and Electrotherapy equipment.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the importance of biomedical measurement in patient monitoring system.
2. Understand the application of the electronic systems in medical applications.
3. Understand and able to interpret the signals like ECG, EMG and EEG.
4. Understand the blood pressure measurement, causes of cardiac failure and remedies for cardiac failure.
5. Understand operation and applications of modern imaging system and Electrotherapy equipment in medical diagnosis.

COURSE CONTENT

Bio-Medical Instrumentation		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Bioelectric signals: Brief introduction to human physiology, Biochemical system, Cardiovascular system, Respiratory system, Nervous system. Origin of bioelectric Signals ECG, EEG, EMG.
Electrode Tissue interface, Metal Electrolyte interface, Electrolyte Skin interface, Recording electrode for ECG- Floating electrode, Limb electrode. Electrode for EEG, Electrode for EMG.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Transducers and Biomedical Recorder: Pressure transducer-LVDT, strain gage transducer. Transducer for Temperature measurement, Thermocouples, Thermometer, Thermistor. Pulse sensor-Photo Electric pulse sensor. Recording Systems-Basic recording system, General consideration for bioelectric recorder amplifier, Sources of noise in low level recording system.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Patient Monitoring and Patient Safety: ECG machine, isolated amplifier in ECG machine. EEG machine, EMG machine. Patient monitoring system- Bedside monitor, Patient Safety-Electric shock hazards, Leakage currents, Precautions to minimize Electric shock hazards, Types of Leakage currents, Methods to reduce Leakage currents, Test instruments for checking safety parameter of biomedical equipment.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Biomedical Measurement and Therapeutic Equipment's: Measurement of heart rate, Average heart meter. Instantaneous heart rate meter. Blood pressure measurement-Direct method, Indirect method of blood pressure measurement - korotkoff' method, Rheographic method. Cardiac pacemakers-External pacemakers, implantable pacemakers, programmable pacemaker. Cardiac defibrillators-DC defibrillators, Defibrillator electrode.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Modern imaging system and Electrotherapy Equipment: Properties of x-ray, units of X-ray, production of x-Rays, x ray machine, X-ray image intensifier television system. Computed Tomography Principle, System component. Electrotherapy equipment-Shortwave diathermy machine Microwave diathermy machine, ultrasonic diathermy machine.

Textbooks:

1. Leslie Cromwell, Fred J. Weibell, Erich Pfeiffer, "Biomedical Instrumentation and Measurement", PHI, Eastern Economy Edition, Second edition, 2003.
2. John. G. Webster, "Medical Instrumentation, Application and Design", John Wiley and sons publication, Fourth Edition, 2010.

Reference Books:

1. R. S. Khandpur, Handbook of biomedical Instrumentation, Tata McGraw Hill publishing Company limited, Third Edition, 2014.

Electrical Drives Laboratory					
LAB COURSE OUTLINE					
Course Title:	**Electrical Drives Laboratory**	**Short Title:**	**EDL**	**Course Code:**	

Course description:

The course aims to give a practical exposure to Electrical Drive System. It is considered that students have prior knowledge of Electrical Machines and Power Electronics. The control techniques for AC and DC motors fed converters are discussed. Different applications related to AC and DC drives are also highlighted.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Electrical Machines, Control System, Power Electronics

Course objectives:

The object is to select proper motor for given load characteristic. Selection of motor based on load characteristic, electrical, mechanical characteristic, and service duty. The practical also provides the knowledge of electric drives, operation, and control of electrical drives. The subject provides brief knowledge of four quadrant operation of drives.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply the knowledge of electrical engineering subjects in different application of industries like manufacturing, maintenance, operation, and safety.
2. Understand different speed control methods in D.C and A.C motors using thyristors-based control schemes.
3. Understand the characteristic of load and selection of derive in industrial sectors.
4. Conduct practical and analyze data for proper selection of derive in realistic constrain of load requirement.
5. Understand the impact of electrical characteristic of motor in electric traction system.

LAB COURSE CONTENT

Electrical Drives Laboratory		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments:

1. Determination of Speed Torque characteristic of d.c. motor controlled using single phase half-controlled rectifier.
2. Determination of Speed Torque characteristic of d.c. motor controlled using single phase fully controlled rectifier.
3. Performance analysis of one quadrant chopper control of d.c. motor.

4. Performance analysis of two quadrant chopper control of d.c. motor.
5. Speed control of single-phase induction motor using a.c. voltage regulator.
6. Study of stepper motor drive circuit.
7. Speed control of universal motor.
8. Study of closed loop control of d.c. motor.
9. Study of vector control method for induction motor.
10. Study of reversible drives

Note: Lab file should consist of minimum Eight experiments.

Textbooks:

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House, 2nd edition, 2002.
2. S.K. Pillai, "A First Course on Electric Drives", New Age International Publishers, 3rd edition, 2012.
3. B.N. Sarkar, "Fundamental of Industrial Drives", Prentice Hall of India Ltd., 2012.

Reference Books:

1. M. Chilkin, "Electric Drives", Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore, 2nd edition, 2017.
3. N. K. De, Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd., 2014.
4. V. Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill, 1994.

Guidelines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paperwork, performance and understanding.

MATLAB and its Applications

LAB COURSE OUTLINE

Course Title:	**MATLAB and its Applications**	**Short Title:**	**MATLAB LAB**	**Course Code:**	

Course description:

The objective of this course is to introduce the students to the fundamental concepts of MATLAB and enable them to apply these concepts for solving real world problems. This course includes the basic structure and statements required for simple mathematical problems in MATLAB. This course provides the basic concepts of plot and other useful tools required to solve the problems.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**01**	**14**	**14**	**02**
Laboratory	**02**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Basic sciences, mathematics and subjects of Electrical Engineering, C and C++

Course objectives:

1. To familiarize the student in introducing and exploring MATLAB/Simulink.
2. To enable the student on how to approach for solving Engineering problems using simulation tools.
3. To prepare the students to use MATLAB/Simulink in their project works
4. To provide a foundation in use of this softwares for real time applications.
5. To use the MATLAB/Simulink for solving complex engineering problems.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Implement small and medium programs of varying complexity using the most used features of the language.
2. Employ good programming style, standards and practices during program development.
3. Solve the different numerical techniques and perform Matrix operations
4. Understand and use of MATLAB/Simulink for solving simple electrical engineering problems.
5. Use modern engineering tools in MATLAB/Simulink which are useful for analyzing and designing of electrical power system

LAB COURSE CONTENT

MATLAB and its Applications		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**1 hours/week**	**End Semester Exam (ESE):**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Theory:

Unit–I: Introduction to Matlab/Simulink

Standard Matlab windows, Operations with variables: naming, checking existence, clearing and operations, Arrays: columns and rows: creation and indexing, size & length, multiplication, division, power and operations.

Unit–II: Writing script

Writing script files: logical variables and operators, flow control and loop operators

Writing functions: input/output arguments, function visibility, path, and Matlab Startup Simple graphics: 2D and 3D plots and figures and subplots

Unit–III: Data and data flow in Matlab

Data types: Matrix, string, cell and structure, creating, accessing elements and manipulating of data of different types. File Input-Output: Matlab files, text files, binary files, mixed text-binary files.

Unit–IV: Introduction to Simulink

Simulation steps, Types of mathematical model, developing a model, Simulink solution of differential equation, solvers, assigning variables, Observing variable during simulation. Storing or saving data, linking script file with model file, Data import/export, Creating and masking subsystems

Unit–V: Applications of MATLAB/Simulink

Simulation of R-L-C series circuit, Finding laplace transform and inverse laplace transform using MATLAB, Step response using MATLAB, Root locus and Bode plot, Simulation of Single phase half wave and full wave rectifiers, battery charger, Effect of source inductances, Simulation of controlled converters and AC voltage controller.

Teacher should facilitate learning following lab experiments:

1. A. Simple Arithmetic Calculation: Perform simple arithmetic calculations:
    a. Addition, subtraction, multiplication, division, and exponentiation.
    b. Assign values to variables.
    c. Suppress screen output.
    d. Control the appearance of floating-point numbers on the screen.
2. Create: Simple sine plot, line plot, an exponentially decaying sine plot, space curve, log scale plot, Overlay plot and Fancy plots.
3. Write a program to find transient response in RC and RL circuit.
4. Write a program to plot voltage and current in inductive and capacitive circuit
5. Build a simple circuit with Power System blocks and connect it to other Simulink Blocks
6. Create an electrical subsystem, simulate transients, and discretize simple circuits
7. Single phase fully controlled converter using R and RL load using MATLAB /Simulink.
8. Single phase AC voltage regulator using MATLAB / SIMULINK
9. Step response without and with derivative control
10. Obtain the step and ramp response of the control system.

Note: Lab file should consist of minimum **Eight** experiments.

Textbooks:

1. Dr. Shailendra Jain, “Modeling & Simulation using MATLAB-Simulink”, Wiley India, 2013.
2. Rudra Pratap, “Getting Started with Matlab: A Quick Introduction for Scientists and Engineers” Oxford University Press, 2011.

Reference Books:

1. Using MATLAB Graphics, Version 10, The Math Works, Inc., 2012.

2. MATLAB Release Notes for Release 12, The Math Works, Inc., 2012.
3. Sivanandam S.N., Sumathi S., Deepa S. N., “Introduction to Fuzzy Logic using MATLAB”, Springer-Verlag Berlin Heidelberg, 1st edition, 2007.
4. S. Sivanandam, S. Sumathi, “Introduction to Neural Networks Using MATLAB”, McGraw Hill Education, 1st Edition, 2017.

Guidelines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paperwork, performance and understanding.

Project (Stage – I)					
LAB COURSE OUTLINE					
Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	12	**14**	**168**	**06**
End Semester Exam (ESE) Pattern:			**Oral (OR)**	
Prerequisite course(s):				

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation, and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills, and attitudes of a professional engineer.

LAB COURSE CONTENT			
Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**12 hours/week**	**End Semester Exam (ESE): (OR)**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

At the final year the students shall carry out a project in a group of maxima up to 5 students. The project work spans both the semesters. By the end of Semester – VII the students shall complete the partial work, and by the end of Semester – VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project shall involve both theoretical and practical work to be assigned by the Department. The work may also be on specified task or project assigned to the students during Internship or R & D work.

Project (Stage – I) may involve literature survey, problem identification, work methodology preparing specification and material procurement, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design, or analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII.

Each student group is required to maintain separate logbook for documenting various activities of the project.

Guidelines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (stage – I) in Semester – VII shall be as per the guidelines given in Table – 1.

Table – 1

		Assessment by Guide					**Assessment by Departmental Committee**		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation/demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic lifestyle of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific worldview, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:

Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:

Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.

5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.

9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.
11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Syllabus for
Final Year Electrical Engineering

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE

Semester – VIII

w. e. f. 2021 – 22

Power System Protection					
COURSE OUTLINE					
Course Title:	**Power System Protection**	**Short Title:**	**PSP**	**Course Code:**	

Course description:

A protection scheme in a power system is designed to continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment and property. The subject explores the knowledge of arc interruption, different type of circuit breakers and relay. This knowledge is help full for understanding the characteristic feature and proper selection of protective elements in different protective scheme. The subject also provides knowledge different protection for major and individual power system elements.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	**14**	**42**	**03**

Prerequisite course(s):

Power System-I, Power System-II

Course objectives:

The objectives of subject are that students will ably understanding the fault characteristic of individual power system elements. One should also be knowledgeable about the tripping characteristics of various protective relays. The students able to understand the job of protection engineer is to devise such scheme where closest possible match between the fault characteristic and tripping characteristic is obtained. The students will be able to understand protected zone and able to design protective scheme such that relay will detect undesirable conditions and then trip to disconnect the area affected but remain restrained at all other time. Student should be equipped with sound concept of power system protection to enable those handling unforeseen circumstances in real life.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply the basic knowledge of science for understanding arc generation and interruption in medium and high voltage circuit.
2. Discuss construction operation and specifications of different circuit breakers used in power system.
3. Define basic relay and their role in protection system.
4. State relay based on modern techniques and their role in protection scheme.
5. State different protection scheme used in power system.

COURSE CONTENT

Power System Protection		Semester:	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Arc Phenomena and Interruption: Basic requirement of Switching and protection, arc phenomenon, maintenance of arc, properties of arc, interruption theories, transient recovery Voltage, transient analysis, RRRV, Interruption of capacitive current, current chopping.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Circuit Breakers and Fuses: Construction & Operation, class, breaking capacity, characteristic and application of: Minimum oil circuit breaker, air blast circuit breaker, SF6, Vacuum Circuit Breaker, Earth leakage & Miniature circuit breaker, HRC fuses and HVDC circuit breaker.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Protective Relay-I: Protection system and its attributes: sensitivity, selectivity, speed, reliability and dependability, trip circuit, organization of protection, zones of protection and maloperation. Construction, working and characteristic features of electromagnetic relay: Over current, instantaneous over-current, definite time over-current, inverse time over-current relay, directional over current relay and differential relay.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Protective Relay-II: Construction, working and characteristic features of electromagnetic relay: Impedance relay, reactance relay, Mho relay and their trip law using universal torque equation. Static Over current relay: Single and double actuating quantity relay, basic principle of static over current relay and directional over current relay.

Evolution Digital relay: basic component of digital relay, digital subunits digital relay as unit. Microprocessors based relay, block diagram, relay for motor and advantages.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Protection Schemes: Different type of protective scheme: Over current protection, Differential protection, earth fault protection, distance protection and carrier aided protection. Protective scheme for generator, transformer, busbar, transmission line and motor.

Textbooks:

1. Sunil S. Rao, "Switchgear Protection and Power Systems", Khanna Publishers, 14th edition, 2019.

Reference Books:

1. Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", PHI Publications, Second Edition, 2013.
2. T.S. Madharao, "Power System Protection: Static Relays with Microprocessor Applications", Tata McGraw Hill, Second Edition, 2017.
3. B. Ravindranath, M. Chandar, "Power System Protection & Switchgear", New Age International Publishers, Second Edition, 2018.
4. B. Ram, D.N. Vishwakarma, "Power System Protection & Switch Gear", Mc Graw Hill Education, Second Edition, 2017.
5. Stanley H. Horowitz, Arun G. Phadke, "Power System Relaying", Wiley Blackwell Publications, Third Edition,.2008.

6. J.B. Gupta, “Fundamentals of Switchgear and Protection”, S.K. Kataria and Sons Publishers, 2013.
7. http://nptel.iitm.ac.in

Flexible AC Transmission System and Power Quality (Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Flexible AC Transmission System and Power Quality**	**Short Title:**	**FPQ**	**Course Code:**	

Course description:

Flexible AC Transmission System (FACTS) is one aspect of the power electronics revolution that is taking place in all area of electric energy. In the transmission area, application of power electronics consists of HVDC and FACTS. Is a new technology based on power electronics offers an opportunity to enhance controllability, stability, and power transfer capability of AC transmission system? The subject also explores the knowledge of power quality, effect, and source of power quality.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power System, Power Electronics

Course objectives:

This course will develop an understanding of the control and operation of Flexible AC Transmission system. The effect of different FACTs devices to the operation and control of power system will be presented. This course also studies the enhancement of controllability, stability, and power transfer capability of AC transmission system. Study the fundamental concept of power quality and different power quality issues.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply basic knowledge power electronic for enhancing power transfer capability of AC transmission system.
2. Understand FACTS, concepts its location in transmission network.
3. Analyze the characteristics FACTS controller and able to solve engineering problems.
4. Understand the sources of harmonics and its mitigation.
5. Discharging duties as power system engineer in technical and professional way.

COURSE CONTENT

Flexible AC Transmission System and Power Quality		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

FACTS Concept: Transmission interconnection and opportunity for FACTS, Basic type of FACTS controller, Brief description of FACTs controller: Shunt, series and combination of shunt and series. Comparison of HVDC and FACTS.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Static Shunt Compensators: SVC and STATCOM: Object of shunt compensation, Midpoint voltage regulation for line segmentation, end of line voltage support. Method of controllable VAR generation: variable impedance type and switching type VAR generators, STATCOM.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Static Series Compensators: Objectives of Series Compensation: Concept of series capacitive compensation, voltage stability. Variable impedance type series compensators: Thyristor switched series capacitor (TSSC) and Thyristor controlled series capacitor (TCSC).		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Power Quality: Power quality definition, need for power quality, nonlinear loads, Type of power quality problems: voltage sags, voltage swells, under-voltage, interruption, transients, voltage unbalance, voltage fluctuation, harmonics, and electrical noise. Sources of power quality problems.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Power Quality effects and Solutions: Effect of harmonics in pure resistive, inductive, and capacitive circuit, effect of harmonic on induction motor, transformer, power factor correction and lighting installation. Power quality standard and mitigation by active and passive filter.		
Textbooks:		
1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1st edition, 1999 2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Pvt Ltd; 2nd edition, 2016. 3. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 3rd edition, 2017.		
Reference Books:		
1. T. J. E. Miller, "Reactive Power Control in Electric Systems", Wiley India Pvt Ltd., 2010. 2. G. T. Heydt, "Electric Power Quality", Stars in Circle Publications, 2nd edition, 1991.		

Power Converter Applications (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Power Converter Applications**	**Short Title:**	**PCA**	**Course Code:**	

Course description:

Power electronics converters stresses a power semiconductor device beyond the rating, how to relieve the problems. Power electronics has already found an important place in modern technology and has revolutionized control of power and energy. As the voltage and current ratings and switching characteristics of power semiconductor devices keep improving, the range of applications continues to expand in areas such as lamp controls, power supplies to motion control, factory automation, transportation, energy storage, megawatt industrial drives, photovoltaic system and electric power transmission and distribution. The syllabus of Power Converter Applications deals with Switching dc Power Supply, Power conditioners and Uninterruptible Power Supplies, residential and industrial applications, and programmable power electronic system etc.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power Electronics

Course objectives:

Power Electronics provides the interface between two major divisions of electrical engineering viz. electric power and electronics. It is the art of converting electrical energy from one form to another in an efficient, clean, compact, and robust manner for convenient utilization. The objectives of Power Converter Applications is to create an awareness about the general nature of Power electronic devices, key features of various industrial applications, the most important among them being high-voltage dc transmission, static VAR control, switch mode power supplies and programmable power electronic system.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze and design of switch mode power supplies.
2. Describe the role of Power conditioners and Uninterruptible Power Supplies as an enabling technology in various applications.
3. Understand the utilization of power converters for residential applications.
4. Understand the utilization of power converters for industrial applications.
5. Describe the control strategies of power converters using microcontroller and DSP processor.

COURSE CONTENT			
Power Converter Applications		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12
Switching dc Power Supply: Linear power supply, Overview of switching power supply, dc-dc converters with electrical isolation, Control of switch-mode power supply, Power supply protection, Electrical isolation in feedback loop, Designing meet the power supply specifications.		
Unit–II:	**No. of Lectures: 09Hours**	**Marks: 12**
Power conditioners and Uninterruptible Power Supplies: Power line disturbances, Power conditioners, Uninterruptible Power Supplies: on-line, offline. High-Voltage dc Transmission, control of HVDC transmission, Static VAR control		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Residential Applications: Static switch using Thyristor, Static switch using Traic, DC static switch, low power flasher, Solid-state relays, Light dimmer, Electronic timer, Electronic alarm, Electronic Crowbar, Battery charger, Battery charging regulator, Emerging lighting system.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Industrial Applications: Temperature control, Liquid-level control, Alarm actuator, Ambient-light control power switch, Constant slope ramp generator, High frequency welding system, Induction heating system.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Programmable Power Electronic System: Microprocessor based firing circuit for thyristor converters, Microprocessor based electric drives, Microprocessor based speed control of an AC motors, Microprocessor based process control system, DSP based control, Fuzzy logic control of DC drives, Fuzzy logic control of an induction motor, Fuzzy logic control of a stepper motor.		
Textbooks:		
1. Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, Third Edition, 2014. 2. V. R. Moorthy, "Power Electronics Devices Circuit and Industrial Applications", Oxford University Press, First Edition, 2015. 3. Alok Jain, "Power Electronics and its Applications", Penram International Publishing (India) Pvt. Ltd., Third Edition, 2016.		
Reference Books:		
1. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2014. 2. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, International Second Edition, 2016. 3. SCR manual, General Electric, Sixth Edition, 1979.		

HVDC Transmission Systems (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**HVDC Transmission Systems**	**Short Title:**	**HVDCTS**	**Course Code:**	

Course description:

This course introduces the fundamental concepts, principles, analysis, and design of high voltage direct current transmission system. Modern DC power transmission is relatively new technology because of advent of thyristor valves and related technology. The HVDC technology is still undergoing many changes due to continuing innovations directed at improving reliability and reducing cost of converting station. The subject explores the knowledge of HVD in economic and technical constraint.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power System, Power Electronics

Course objectives:

1. To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
2. To analyze HVDC converters.
3. To study about the HVDC system control.
4. To analyze voltage stability problem in DC system.
5. To model and analysis, the DC system under study state.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the advantages of dc transmission over ac transmission.
2. Understand the operation of Line Commutated Converters and Voltage Source Converters.
3. Understand the control strategies used in HVDC transmission system.
4. Understand the improvement of power system stability using an HVDC system.
5. Understand the multi terminal HVDC transmission system.

COURSE CONTENT

HVDC Transmission Systems		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

DC Transmission Technology: Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Analysis of Line Commutated and Voltage Source Converters: Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six-pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Control of HVDC Converters: Principles of Link Control in LCC HVDC system. Control Hierarchy, Firing Angle Controls– Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Components of HVDC systems: Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems. DC breakers. Monopolar Operation. Ground Electrodes. Stability Enhancement using HVDC**.** Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
MTDC Links: Multi-Terminal and Multi-In feed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.		
Textbooks:		
1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 3rd edition, 2017. 2. S. Rao, "EHVAC & HVDC Transmission Engineering & Practice", Khanna Publications, 3rd edition, 1993.		
Reference Books:		
1. J. Arrillaga, "High Voltage Direct Current Transmission", Institution of Electrical Engineers, 2nd edition, 2008. 2. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.		

Power System Restructuring (Professional Elective Course – V)					
COURSE OUTLINE					
Course Title:	**Power System Restructuring**	**Short Title:**	**PSR**	**Course Code:**	

Course description:

The restructuring of power industry has changed the way of operation of the power systems. Along with the secured and reliable operation of power systems, the economic efficiency has become an equally important consideration. Unlike the knowledge of conventional operation of power systems, understanding the restructured power systems requires basic knowledge of electrical engineering, power systems, and the economics. This course is intended to provide a comprehensive treatment towards understanding of the new dimensions associated with the power systems. The course will initially bring out the differences between the conventional power system operation and the restructured one. Before tackling taxing, issues involving techno-commercial solutions, the course will prepare a background with fundamentals of microeconomics.

The design of power markets and market architectural aspects will be discussed next. With this foundation, the changes in operational aspects with new operational challenges like congestion management and ancillary service management will be elaborated. Efficient pricing of transmission network usage is a must to bring economic efficiency in the power market operation. These issues will follow next. There will be separate modules on Genco bidding strategies and market power with mitigation techniques. Towards the end, the discussion on restructuring experiences of different countries all around the world will be provided. Also, there will be exclusive module on reform practices in developing countries with special focus on Indian power system. The course will be enriched with solved examples to illustrate various concepts. Also, case studies on deeply researched topics will be provided. The emphasis of the course will be on bringing out new concepts in a simple and lucid manner.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**12**	**42**	**03**

Prerequisite course (s):

Power System I, Power System II

Course objectives:

1. To educate students about the process of restructuring of power system
2. To familiarize students about the operation of restructured power system
3. To teach students pricing of electricity.
4. To gain knowledge of fundamental concept of congestion management
5. To analyze the concept of location marginal pricing and transmission rights.
6. To provide in-depth understanding of operation of deregulated electricity market systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and to summarize the role of various entities in the market.

COURSE CONTENT				
Power System Restructuring		**Semester:**	**VIII**	
Teaching Scheme:		**Examination scheme**		
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Power Sector in India: Institutional structure before reforms. Roles of various key entities in India. Necessity of Deregulation or Restructuring. RC Act 1998 and Electricity Act 2003 and its implications for Restructuring & Deregulation. Institutional structure during reform. National Energy policy. Introduction to Energy Exchange and trading of Renewable Energy Credits and Carbon Credits.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Fundamentals of Economics: Introduction to various concepts such as capital cost, debt and equity, depreciation, fixed and variable costs, working capital, profitability indices etc. Typical cost components of utilities such as return in equity, depreciation, interest and finance charges, O and M expenses. Key Indices for assessment of utility performances. Principles of Tariff setting, Phases of Tariff determination, consumer tariff & non-price issues.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Power Sector Regulation and Congestion Issues: Regulatory process in India, types, and methods of Regulation, cost plus, performance-based regulation, price cap, revenue cap regulation, rate of return regulation, benchmarking, or yardstick regulation. Role of regulatory commission. Considerations of socio-economic aspects in regulation.

Congestion in power network, reasons for congestion, classification of congestion management, useful definitions. Methods of congestion management, Locational Marginal Pricing (LMR), Firm Transmission Right (FTR). Availability based Tariff (ABT) in India.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Restructuring: Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Competition for the market vs competition in the market, International experience with electricity reform – Latin America, Nordic Pool, UK, USA, China, and India. California Energy Crisis.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Electricity Markets: Trading **–** electricity marketplaces, rules that govern electricity markets, peculiarity of electricity as a commodity, various models of trading arrangements – integrated trading model, wheeling trading model, decentralized trading model. Various electricity markets such as spot, day ahead, forward, future options, reserve, ancillary services market. Market operation, settlement process, Market Clearing Price (MCP), Market power, market efficiency. Spot, dynamic, and locational pricing.

Textbooks:
1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility", CRC Press, 2017. 2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Springer Science & Business Media, 2012.
Reference Books:
1. Sally Hunt, "Making competition work in electricity", John Willey and Sons Inc., 2002. 2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2002. 3. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", CRC Press, 2nd edition, 2018.

Electric and Hybrid Vehicles (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Electric and Hybrid Vehicles**	**Short Title:**	**EHV**	**Course Code:**	

Course description:

This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The material for this course will be prepared in such a manner that it will be useful for post-graduate students, teachers, practitioners, and final year undergraduate students.

This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Electric Machines and Drives, Power Electronics

Course objectives:

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies, and fundamentals.
2. Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
3. Analyze various electric drives suitable for hybrid electric vehicles
4. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies, and fundamentals.
2. Analyze the use of different power electronics devices and electrical machines in hybrid Electric vehicles.
3. Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
4. Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.
5. Analyze the use of different energy management strategies used in hybrid and electric vehicles

COURSE CONTENT

Electric and Hybrid Vehicles		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**

	Duration of ESE:	**03 hours**
	Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Hybrid Electric Drivetrains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Electric Trains: Electric Drivetrains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Textbooks:

1. C. Mi, M. A. Masrur, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley-Blackwell, 2nd edition, 2017.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer; 1st edition, 2015.

Reference Books:

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd edition,

2011.
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 1st edition, 2004.
3. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 1st edition, 2008.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 1st edition, 2016.

Advanced Electric Drives (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Advanced Electric Drives**	**Short Title:**	**AED**	**Course Code:**	
Course description:					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):
Electrical Machines, Control Systems, Power Electronics
Course objectives:
Electrical drives play an important part as electromechanical energy converters in transportation, materials handling and most advanced production processes. The course tries to give unified treatment of complete electrical drive systems, including the mechanical parts, electrical machines, and power converters and control.
Course outcomes:
After successful completion of this course the student will be able to:
1. To acquire the knowledge of selection of drives as per practical operational industrial requirement. 2. To apply their knowledge to prepare control schemes as per different types of motors used in industries. 3. To estimate & solve harmonic and power factor related problems in controlling AC and DC drives. 4. To acquire knowledge of various control techniques used in electoral drives. 5. To study the practical use of drives and its control for different applications.

COURSE CONTENT			
Advanced Electric Drives		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

DC Motor Drive and its Operational Strategies & Modeling and Control of DC Drives: Dynamic model of machine with armature voltage control only and converters with continuous conduction only; Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper. State feedback control and sliding mode control of excited DC machine in field–excited DC machine, Modeling, and control of separately–separately weakening region and discontinuous converter conduction mode, Control of DC series machine.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Open-loop Dynamic Performance of AC & DC Drives: Starting & reversal time, Energy consumption & energy savings principle. Drives Application Engineering for Fan, Pump, Compressor, Lift-Elevator, Kiln, Winder-Un-Winder, Traction application. Synchronization and master-slave configuration.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
AC Drives and its Operational Strategies: Variable frequency operation of three phase symmetrical–induction machine, Scalar control methods for constant power an constant torque modes, Vector control of induction machine, Methods of field sensing and estimation, Field orientation methods: Implementation of IRFO scheme using current controlled PWM, VSI and implementation of DSFO scheme using CSI, Performance of vector controlled permanent magnet machine.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Control and Estimation of AC Drives: Introduction to speed control of Switched Reluctance Machine, Induction motor drive, basic of Scalar & Vector control V/f Control, Sensor less vector control, Field Oriented Control, Direct torque control and flux observation, Speed control of wound rotor induction motors: Converter based static rotor resistance control, Static scherbius drive using line commutated converter cascade, Analysis and estimation of harmonics and power factor, Vector control of wound rotor induction machine using self-commutated converter cascade and improvement in power factor, Variable speed constant frequency (VSCF) generation.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Control of Permanent Magnet Machine & Compatibility to Motor & Drives: Power Electronics Control of Permanent magnet synchronous machine, Brushless DC machine, Surface permanent magnet machine and interior, Effects of drives on motor - dV/dt, THD, Common Mode Voltage, Shaft Voltage and Bearing Current, Sound & Vibration Laboratory Work: Closed loop current-speed control of AC & variable–DC drives, Variable voltage frequency control, Vector control mechanism, Position control of stepper motor.		

Textbooks:

1. P. C. Krause, O. Wasynczuk, S. D. Sudoff, “Analysis of Electric Machinery and Drive System”, John Wiley and Sons, 2013.
2. B.K. Bose, “Modern Power Electronics and Electric Drives”, Pearson Education, Asia, 2003.
3. B.N. Sarkar, “Fundamental of Industrial Drives”, Prentice Hall of India Ltd.

Reference Books:

1. M. Chilkin, “Electric Drives”, Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore.
3. N.K. De and Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd.
4. V. Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill.

EHV AC Transmission Systems (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**EHV AC Transmission Systems**	**Short Title:**	**EHVAC**	**Course Code:**	

Course description:

This course introduces the concepts of extra high voltage AC transmission. It also emphasis on the behavior of the line parameters for extra high voltages, voltage gradients of the transmission line conductors' gradients, the effect of corona, electrostatic field calculations, voltage control when the line carries extra high voltages.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Power System-I, Power System-II

Course objectives:

The need for energy is very urgent in the developing countries, and national policies and their relation to other countries are sometimes based on energy requirements, chiefly nuclear, hydro-electric and coal or oil-fired stations are located very far from load centers for various reasons which require the transmission of the generated electric power over very long distances. This requires extremely high voltages for transmission. The very rapid strides taken by development of DC transmission since 1950 are playing a major role in extra-long-distance transmission, complementing or supplementing EHV AC transmission.

Course outcomes:

After successful completion of this course the student will be able to:

1. To understand the need of EHV Transmission system.
2. To calculate line and ground parameters.
3. To describe the impact of high voltage level on the environment.
4. To understand Electrostatic and Magnetic fields of EHV lines.
5. To understand corona and its effect on EHV Transmission system.

COURSE CONTENT

EHV AC Transmission Systems		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction, Transmission Line Trends and Preliminaries: Basic aspects of AC Power Transmission, Need for EHV transmission lines, Role of EHV AC Transmission, Power handling capacity and line loss, Examples on giant power pools and number of lines, Cost of Transmission lines and equipment, Mechanical considerations in line performance- types of vibrations and oscillations**.**

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Calculation of line and Ground parameters: Resistance of conductors, Temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of EHV line configurations, line capacitance calculations, sequence inductance and capacitances.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Voltage gradient of conductors: Electrostatic, Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, charge potential relations for multi-conductor lines, Maximum charge condition on a three-phase line. Surface voltage gradient on conductors-single conductor, two conductors' bundle, Maximum surface voltage gradient, Mangoldt formula, design of cylindrical cages for corona gradients

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Electrostatic and Magnetic fields of EHV lines: Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level. Electrostatic field of a double circuit 3 phase AC line, Insulated ground wire and induced voltage in insulated ground wires.

Magnetic field calculation of horizontal configuration of single circuit of three phase lines, Effects of power frequency magnetic fields on human health.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Corona and its effects: Corona formation, visual critical voltage, corona power loss, corona loss formulae, charge-voltage diagram, increase in effective radius of conductor and coupling factors, attenuation of travelling waves due to corona loss. Audible noise – generation and characteristics, limits for audible noise, AN measurement, and meters- microphones, weighting networks.

Textbooks:

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Publishers, Third Edition, 2007.

Reference Books:

1. A. Chakrabarti, D.P. Kothari, A.K. Mukhopadhyay, "Performance Operation and Control of EHV Power Transmission Systems", Wheeler Publishing, 1999.
2. S. Rao, "EHV-AC, HVDC Transmission and Distribution Engineering", Khanna Publishers, Third Edition, 2017.
3. http://nptel.iitm.ac.in

Illumination Engineering (Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Illumination Engineering**	**Short Title:**	**IE**	**Course Code:**	

Course description:

The explores the knowledge of types of illumination , lighting systems, lighting Scheme , measurement of might, laws of illumination, design of Interior Lighting, Indian standard recommendation and standard practices for illumination levels in various areas, design of outdoor lighting and special features of aesthetic lighting .

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

To introduce the fundamentals of illumination engineering and architectural lighting design. To impart lighting fundamentals, measurement, and technology and their application in the analysis and design of architectural lighting systems. Factors to be considering while designing indoor and outdoor illumination schemes.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply basic engineering to understand concept of lighting system, selection of lighting factors effecting on lighting scheme.
2. Identify the criteria for the selection of lamps, measurement of light and law of illuminations. and lighting systems for an indoor or outdoor space.
3. Design and Evaluate different types of lighting scheme designs for indoor lighting and selection of luminary to meet the specified needs with appropriate consideration.
4. Perform calculations on photometric performance of light sources and luminaries for outdoor purposes.
5. Design special lighting scheme to meet the specified needs with appropriate consideration in monument Sports and aviation lighting.

Illumination Engineering

COURSE CONTENT

Illumination Engineering		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction of Light: Radiation, color and eye vision. Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Color rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localized

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Light Source and measurement light: Incandescent, electric discharge, fluorescent and LED light, Luminaries and control circuits. Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Design of Interior Lighting: Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilization and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaries, Calculation of space to mounting height ratio, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Design of Outdoor Lighting: Street Lighting : Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaries, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio, Calculation of illumination level available on road .Flood Lighting Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Auditorium lighting and aviation and transport lighting. Lighting for displays and signaling- neon sign, LED LCD displays and lighting for surveillance.

Textbooks:

1. Gupta J. B., "Utilization of Electric Power & Electric Traction" S. K. Kataria & Sons, 2nd edition, 2012.
2. Uppal S. L, "Electrical Power", Khanna Book Publication, 13th edition, 1988.
3. Partab H. P., "Art & Science of Utilization of Electrical Engineering", Dhanpat Rai Publications, 2017.

Reference Books:

1. Jack L. Lindsey, "Applied Illumination Engineering", Fairmont Pr; 2nd edition, 1996.

2. John Matthews, “Introduction to the Design and Analysis of Building Electrical Systems”, Springer Science & Business Media, 1993.
3. M.A. Cayless, “Lamps and Lighting”, Routledge; 4th edition, 2012.
4. O. E. Taylor, “Utilization of Electrical Energy”, Longman, 1971.
5. H. S. Mamak, “Book on Lighting”, Publisher International lighting Academy
6. Joseph B. Murdoch, “Illumination Engineering from Edison’s Lamp to Lasers” Publisher -York, PA: Visions Communications, 1994.

Digital Signal Processing (Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Digital Signal Processing**	**Short Title:**	**DSP**	**Course Code:**	

Course description:

Digital Signal Processing (DSP) is concerned with the representation, transformation, and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging, power applications and so on. With the dramatic increase of the processing capability of signal processing, it is the expectation that the importance and role of DSP is to accelerate and expand.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Course objectives:

The objective of this course is to provide an understanding of Digital Signal Processing. Topics include: Introduction to digital signal processing and application, discrete time signals and systems; Analysis of LTI systems; Structures of discrete time systems; Filter designing techniques; DFT and FFT.

Course outcomes:

After successful completion of this course the student will be able to:

1. Analyze Discrete Time systems with Discrete Fourier Transform
2. Design digital filters IIR and FIR filters
3. Analyze finite word length effects in signal processing
4. Design filters using
5. Understand Digital Signal Controllers and their Applications

COURSE CONTENT

Digital Signal Processing		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Discrete-Time Signals and Systems: Sequences, discrete time systems, LTI systems, frequency domain representation of discrete time signals and systems, discrete time signals and frequency domain representation, Fourier Transform. Implementation of discrete time systems: Structure for FIR system, Structure for IIR systems.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Sampling of Continuous Time Signals: Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Transform Analysis of LTI Systems: Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase Discrete Fourier Transform: Discrete Fourier Transform, properties, linear convolution and circular convolution.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Filter Design Techniques: Design of IIR filters using Impulse Invariant Response method and Bilinear Transformation method. Butterworth filters and chebyshev Filter's response, Design of FIR filters by windowing, Kaiser Window method, optimum approximations of FIR filters.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Efficient computation of the DFT: FFT algorithms- decimation in time and decimation in frequency, Goertzel algorithm, Implementation of the DFT using convolution, Introduction to wavelet transform: Wavelet comparison with Fourier transforms, Applications of Wavelet cosine transform, Discrete cosine transform (DCT), Block Diagram and features of DSP processors from Texas Instrument i.e TMS320C2812.

Textbooks:

1. S. Salivahanan, "Digital Signal Processing", McGraw Hill Education; 3rd edition, 2017.
2. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications (India) Pvt. Ltd., 6th edition, 2014.
3. Oppenheim A.V., Schafer, Ronald W. & Buck, John R, "Discrete Time Signal processing", Pearson Education, 2nd edition, 1999.
4. Proakis, J.G., Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", Pearson Education India; 4th edition, 2007.

Reference Books:

1. Rabiner, L.R., Gold B., "Theory and applications of DSP", Prentice Hall of India, 2016.
2. Oppenheim, Alan V., Willsky, Alan S., "Signals and Systems", Prentice Hall of India, 2nd Edition, 2015.
3. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, 1st edition, 2015.

Embedded System (Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Embedded System**	**Short Title:**	**ES**	**Course Code:**	

Course description:

The course explores knowledge of embedded system fundamentals and its design aspects. The course comprises of basic understanding of embedded system concepts, role, characteristics, and real time implementation in various application with real time operating system concepts etc.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

Students have knowledge about the basic functions, structure, concept, application, and development of embedded systems and enable the learner to design a system with combination of hardware and software for a specific real time application.

Course outcomes:

After successful completion of this course the student will be able to:

1. Able to understand the role and concept of embedded systems
2. Able to understand the extension in processor, pipelines, memory architecture.
3. Understand the concepts of ARM interfacing in advanced embedded system.
4. Able to identify communicate and interface embedded network protocol
5. Demonstrate the use of open source RTOS and embedded system application, design issues for the same.

COURSE CONTENT

Embedded System		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Embedded Systems: Introduction to embedded systems, history, design challenges - optimizing design metrics, time to market concept, top-down design process and technology, applications of embedded systems and recent trends in embedded systems, processor technology, IC technology and design technology, trade-offs in embedded systems. Custom Single-Purpose Processor Design: Design of general-purpose processor: controller and data path design.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

System Architecture: Introduction to Advance Reduced Instruction Set Computer (RISC) Machine (ARM) embedded systems - RISC versus Complex instruction set computer (CISC) machines, ARM design philosophy, ARM processor fundamentals, ARM extension family, operating modes, pipeline, memory management, bus architecture, exception handling and interrupt structure. Brief introduction to ARM-7 processor LPC2148 block diagram.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

LPC 2148 Interfacing and Programming: need of interfacing, interfacing techniques, basic embedded C programs for GPIO and interfacing of different devices like switches, keypad, Light Emitting Diode (LED), Liquid Crystal Display (LCD), Relay, Stepper Motor. Study and programming of on-chip peripherals like timers, counters, on-chip Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Universal Asynchronous Receiver/Transmitter (UART), Real Time Clock (RTC) modules, Watch Dog Timer (WDT), phase locked loop (PLL), Pulse Width Modulator (PWM).

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Communication Protocol: Basic protocol concept, study of protocols like Serial Peripheral Interface (SPI), Inter-Integrated Circuits (I2C), Controller Area Network (CAN), Ethernet. Wireless Protocols: Infrared Data Association (IrDA), Bluetooth, IEEE802.11 (Wi-Fi), ZigBee, RF modules, etc. Case study of Complementary Metal Oxide Semiconductor (CMOS) camera (without codes), requirement specification, different ways to design of camera.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Real Time Operating System (RTOS) Concept: Need of RTOS in embedded system software, foreground/background systems, multitasking, context switching, IPC, scheduler policies, architecture of kernel, task scheduler, ISR, semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS. Introduction to µC/OS-II RTOS, study of kernel structure of µC/OS-II, synchronization in µCOS-II, inter-task communication in µC/OS-II, memory management in µC/OS-II, porting of RTOS of ARM 2148, Application developments using µC/OS-II.

Textbooks:

1. Raj Kamal, "Embedded Systems", McGraw Hill Education (India) Private Limited, Third edition, 2017.
2. Dr. K.V.K.K. Prasad, "Embedded/Real Time Systems Programming Black Book", Dreamtech Press, New edition, 2003.
3. Frank Vahid, Tony Givargis, "Embedded Systems Design: A Unified Hardware/Software Introduction", John & Wiley Publications, 2002.

Reference Books:

1. Andrew Sloss, "ARM System Developer guide", Elsevier India; First edition, 2004.
2. Data sheet and User manual of LPC2148.
3. Steve Furber, "ARM System-on-Chip Architecture", Pearson, Second edition, 2014.
4. Jean J.Labrose, "Micro C / OS-II", Indian Low Price Edition, second edition, 2002.
5. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Second Edition, 2007.

Robotics (Open Elective Course – IV)					
COURSE OUTLINE					
Course Title:	**Robotics**	**Short Title:**	**ROB**	**Course Code:**	
Course description:					
In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics, and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To understand structures and classifications in robotics
2. To gain knowledge of types of actuators and sensors in robotics.
3. To understand and learn robotic transformations.
4. To know different analysis techniques for robotic kinematics and dynamics.
5. To learn control techniques for robotic programming.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain structure and classification of robots.
2. Define role of actuators, sensors and vision system in robotics
3. Describe various transformations in robots.
4. Analyze the different kinematics and dynamics in robots.
5. Apply control techniques for programming in robotics

COURSE CONTENT

Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Robotics: Robots, History of Robots, Robots Usage, Basic Structure of Robots, Classification of Robots by Applications, classification by Coordinate Systems, Classification by Actuation System, Classification by Control System, Robot classification by programming method.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Robot Actuators, Sensors and Vision: Robot Actuators: Pneumatic, Hydraulic and Electric Robot

Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection Vision System in Robots.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Transformations and Statics in Robotics: Robot Architecture, Pose of Rigid Body, Coordinate Transformation, Denavit and Hartenberg (DH) Parameters, Forces and Moment balance, Recursive Calculations, Equivalent Joint Torque, Role of Jocobian in Statics.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Kinematics and Dynamics: Forward Position Analysis, Inverse Position Analysis, Velocity Analysis, Inerita Properties, Eular- Lagrange Formulation, Newton – Eular Formulation, Recursive Newton – Eular Algorithm		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Robotic Control and Programming: Control Techniques, Second Order Linear Systems, Feedback Control and its Performance, Non-Linear Trajectory Control, State Space Representation and Control, Stability, Cartesian and Force Controls, Robotic Programming		
Textbooks:		
1. Saha S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.		
Reference Books:		
1. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, Wiley; 2nd edition, 2011. 2. Mittal R.K., Nagrath I.J., “Robotics and Control”, Tata McGraw Hill, 2003. 3. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi. 4. Craig, J.J., “Introduction to Robotics: Mechanics and Control”, Pearson, New Delhi, 3rd edition, 2009. 5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modelling and Control”, John Wiley and Sons Inc, 2005. 6. Steve Heath, “Embedded System Design”, 2nd Edition, Newnes, Burlington, 2003.		

Cyber Security (Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Cyber Security**	**Short Title:**	**CS**	**Course Code:**	

Course description:

Cyber Security course focuses on cyber threats and cyber security that provides the much-needed awareness in the times of growing cybercrime episodes.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**14**	**42**	**03**

Prerequisite course(s):

Course objectives:

1. To understand Cybercrime and Cyber offenses.
2. To understand Cybercrime through portable devices.
3. To understand tools and methods used in Cybercrime.
4. To understand Phishing and Identity theft.
5. To understand Computer Forensics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Determine the act of Cyber offenses.
2. Determine the Cybercrime through portable devices.
3. Determine the methods used in Cybercrime.
4. Determine Phishing and Identity theft.
5. Describe Computer Forensics.

COURSE CONTENT

Cyber Security		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes.

Cyber offenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)

Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti forensics

Textbooks:

1. Nina Godbole, Sunil Belapure, “Cyber Security”, Wiley India Publication, 2011.

Reference Books:

1. Nina Godbole, “Information Systems Security”, Wiley India Publication, 2nd edition, 2017.
2. V.K. Pachghare, “Cryptography and Information security”, PHI Learning Pvt Ltd, 2nd edition, 2015.

Power System Protection Laboratory					
LAB COURSE OUTLINE					
Course Title:	**Power System Protection Laboratory**	**Short Title:**	**PSP Lab**	**Course Code:**	

Course description:

Switchgear and Protection is a fascinating subject. A protection scheme in a power system is designed to continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment, and property. The subject practical explores the knowledge of arc interruption, different type of circuit breakers and relay. This knowledge is help full for understanding the characteristic feature and proper selection of protective elements in different protective scheme. The practical also provide knowledge different protection for major and individual power system elements.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**14**	**28**	**01**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Power System-I, Power System-II

Course objectives:

The objectives of subject that students will ably understand the fault characteristic of individual power system elements. One should also be knowledgeable about the tripping characteristics of various protective relays. The students able to understand the job of protection engineer is to devise such scheme where closest possible match between the fault characteristic and tripping characteristic is obtained. The students will ably understand protected zone and able to design protective scheme such that relay will detect undesirable conditions and then trip to disconnect the area affected but remain restrained at all other time. Student should be equipped with sound concept of power system protection to enable those handling unforeseen circumstances in real life.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Analyze the arc formation and arc extinction phenomenon.
2. Analyze Over current & earth fault protection scheme for alternator.
3. Explain Protection of 3 phase transformer using differential relay.
4. Explain differential protection scheme applied to transformer.
5. Demonstrate microprocessor-based protection.

LAB COURSE CONTENT

Power System Protection Laboratory		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

Teacher should facilitate learning following lab experiments:

1. To conduct and study of Arc extinction phenomenon: Application in air circuit breaker.
2. Study of relaying components and control circuit developments.
3. To conduct and plot the characteristic of rewireable fuses and MCB.
4. To conduct and plot operating characteristics of Inverse time over current relay.
5. To conduct over current & earth fault protection scheme for alternator.
6. To conduct Protection of 3 phase transformer using differential relay (Merz- Price protection scheme).
7. To conduct and study the through fault stability of differential protection scheme applied to transformer.
8. To conduct Protection of transmission line.
9. Study of MHO distance relay to plot. a) R- X diagram b) Relay voltage Vs Admittance characteristic.
10. Study of Static relay.
11. Demonstration of microprocessor base protection.

Note: Lab file should consist of minimum Eight experiments.

Textbooks:

1. Sunil S. Rao, “Switchgear Protection and Power Systems”, Khanna Publishers, 14th edition, 2019.

Reference Books:

1. Y.G. Paithankar, S.R. Bhide, “Fundamentals of Power System Protection”, PHI Publications, Second Edition, 2013.
2. T.S. Madharao, “Power System Protection: Static Relays with Microprocessor Applications”, Tata McGraw Hill, Second Edition, 2017.
3. B. Ravindranath, M. Chandar, “Power System Protection & Switchgear”, New Age International Publishers, Second Edition, 2018.
4. B. Ram, D.N. Vishwakarma, “Power System Protection & Switch Gear”, Mc Graw Hill Education, Second Edition, 2017.
5. Stanley H. Horowitz, Arun G. Phadke, “Power System Relaying”, Wiley Blackwell Publications, Third Edition.2008.
6. J.B. Gupta, “Fundamentals of Switchgear and Protection”, S.K. Kataria and Sons Publishers, 2013.
7. http://nptel.iitm.ac.in

Guidelines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paperwork, performance and understanding.

High Voltage Engineering laboratory					
LAB COURSE OUTLINE					
Course Title:	**High Voltage Engineering laboratory**	**Short Title:**	**HVELAB**	**Course Code:**	

Course description:

In this laboratory, course emphasis on imparting practical knowledge and understanding of high voltage testing equipment's, different insulating materials and its breakdown phenomenon, high voltage laboratories and testing of high voltage equipment. The lab course also provides the platform to understand generation and measurement of high voltages.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**02**	**14**	**28**	**03**
Laboratory	**02**	**14**	**28**	

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Basic sciences, mathematics, and subjects of Electrical Engineering

Course objectives:

The objective of the laboratory is to impart the fundamental knowledge of high voltage generating, measuring, and testing instruments. The students will be able to understand concept and breakdown phenomenon of dielectrics, corona discharges, methods of generation and Measurement of high voltages and currents and testing of high voltage equipment's. In this lab course, students will be familiar with the use of different equipment's, safety precautions on workplace. This makes bridge on theoretical knowledge and practical practices.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply the concepts of High Voltage Engineering through laboratory experimental work and Connect the circuit to perform experiments, measure, analyze the observed data to conclude
2. Evaluate the performance of breakdown testing of various dielectrics.
3. Calibrate the breakdown voltage of air using sphere-gap assembly.
4. Visualize and analyze the corona effect.
5. Understand the methods of generation and Measurement of high voltages and currents and testing of various electrical equipment's.

LAB COURSE CONTENT			
High Voltage Engineering laboratory		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**End Semester Exam (ESE):**	**25 marks**
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Theory:

Unit–I: Introduction to High voltage Labs
Classification of high voltage laboratories, High voltage laboratory layout, testing facility requirements, High Voltage laboratories all over the world.

Unit–II: Breakdown in Gases
Gases as insulating media, collision process, ionization process, Breakdown in Electronegative Gases, Corona Discharges, Breakdown in Vacuum.

Unit–III: Breakdown in Liquids and solids
Liquids as Insulators, Conduction and Breakdown in Pure Liquids and Commercial Liquids. Solid dielectrics and composite dielectrics, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Unit–IV: Generation and measurement of High Voltages and currents
Methods of Generation of high dc voltages, ac voltages and impulse voltage, voltage doubler circuit, voltage multiplier circuit, multistage impulse generator, impulse current generator. Spark gap for measurement of high dc, ac and impulse voltages, Klydonograph, other techniques for impulse current measurements

Unit–V: High Voltage Testing of Electrical Apparatus
Various standards for HV Testing of electrical apparatus, IS, ANSI, IEC standards, testing of overhead line insulators, testing of power capacitor, testing of circuit breakers, testing of cables, test voltage.

Teacher should facilitate learning following lab experiments:

1. Study of 100 kV high voltage testing set.
2. Determination of insulating break-down strength of solid, liquid and gaseous dielectric media.
3. Study of corona discharge.
4. Double voltage double frequency withstand test on transformer.
5. Calibration of sphere gap.
6. Study of Impulse Voltage Generator
7. Parametric Analysis of Impulse Voltage Waveform
8. Study of Impulse Current Generator
9. Parametric Analysis of Impulse Current Waveform
10. Critical Flashover of a Sphere Gap using IVG
11. Functioning of Voltage Doubler
12. 3-Stage Cockroft Walton Voltage Multiplier

Note: Lab file should consist of minimum Eight experiments.

Textbooks:

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, Fifth Edition, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age publishers, New Delhi, 3rd edition, 2010.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
4. R. Arora, W. Mosch “High Voltage and Electrical Insulation Engineering”, Wiley-IEEE Press; 1st edition, 2011.
5. http://nptel.iitm.ac.in/courses.php

Reference Books:
1. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2nd edition, 2008. 2. Rakosh Das Begamudre, “High Voltage Engineering, Problems and Solutions”, New Age International Publishers, New Delhi, 2010. 3. D. V. Razevig, “High Voltage Engineering Fundamentals”, Khanna Publishers, 2nd edition, 1993.
Guidelines for ICA:
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paperwork, performance and understanding.

Project					
LAB COURSE OUTLINE					
Course Title:	**Project**	**Short Title:**	**PROJ**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	06	**14**	**84**	**03**
End Semester Exam (ESE) Pattern:	**Oral (OR)**			
Prerequisite course(s):				

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**End Semester Exam (ESE): (OR)**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound.

Each student group is required to maintain separate logbook for documenting various activities of the project.

Guidelines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge/skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – 2.

Table – 2

		Assessment by Guide				**Assessment by Departmental Committee**			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation/demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering

(Electronics and Telecommunication Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII & VIII

W.E.F. 2021 – 22

Syllabus Structure for Final Year Engineering (Semester – VII) (Electronics and Telecommunication Engineering) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Digital Signal Processing	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Communication Lab - I	D	-	-	2	2	-	-	25	25 (PR)	50	1
Digital Signal Processing Lab	D	1	-	2	3	-	-	25	25 (PR)	50	2
Project (Stage – I)	G	-	-	12	12	-	-	50	50 (OR)	100	6
Essence of Indian Traditional Knowledge	H	-	-	-	-	-	-	-	-	-	-
		13		**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Fiber Optic Communication	1	Satellite Communication	1	Artificial Intelligence and Machine Learning
2	Speech and Audio Processing	2	Digital Image and Video Processing	2	Big Data Analysis
3	Nanoelectronics	3	Mixed Signal Design	3	Mechatronics

Syllabus Structure for Final Year Engineering (Semester – VIII) (Electronics and Telecommunication Engineering) (w.e.f. 2021 – 22)
(As per AICTE Guidelines)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Computer Network	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3
Communication Lab - II	D	-	-	2	2	-	-	25	25 (OR)	50	1
Computer Network Lab	D	2	-	2	4	-	-	25	25 (PR)	50	3
Project	G		-	6	6	-	-	50	50 (OR)	100	3
		14	**0**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V		Professional Elective Course – VI		Open Elective Course – IV	
1	Microwave Theory and Technique	1	Embedded System	1	Automotive Electronics and Electric Vehicle
2	Adaptive Signal Processing	2	Mobile Communication and Network	2	Cyber Security
3	Antenna and Wave Propagation	3	High Speed Electronics	3	Robotics

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Final Year Engineering

(Electronics and Telecommunication Engineering)

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS

Semester – VII

W.E.F. 2021 – 22

Digital Signal Processing					
COURSE OUTLINE					
Course Title:	**Digital Signal Processing**	**Short Title:**	**DSP**	**Course Code:**	

Course description:

Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging, power applications and so on. With the dramatic increase of the processing capability of signal processing, it is the expectation that the importance and role of DSP is to accelerate and expand.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Knowledge of Mathematics, control system, Signal and System.

Course objectives:

The objective of this course is
1. To introduce finding DFT, IDFT and FFT of discrete signal.
2. To design IIR filter form analog filters.
3. To convert IIR filter to FIR filters using various techniques.
4. To introduce finite world length effect in digital filter and multirate signal processing.
5. Study of DSP processor and its application.

Course outcomes:

After successful completion of this course the student will be able to:
1. Able to understand findings the DFT, IDFT and FFT of discrete signal.
2. Understand the concept of analog filter and design of IIR digital filters.
3. Understand the need and design of FIR digital filters.
4. Analyze finite word length effects on signal and multirate signal processing
5. Understand Digital Signal Controllers and their Applications

COURSE CONTENT

Digital Signal Processing		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Discrete Fourier Transform & Fast Fourier Transform
DSP Preliminaries

Discrete time signals: Sequences; representation of signals on orthogonal basis, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.
Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT

(Maximum N=8). Twiddle factor. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, and introduction to composite FFT.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

IIR Digital Filters
Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters by impulse invariance method, Bilinear transformation method.
IIR filter realization using direct form, cascade form, parallel form and transposed form.
Butterworth filter, Chebyshev, Elliptic Approximation
Lowpass, High pass, Bandpass and Bandstop filters design using frequency transformation (Design of all filters using Lowpass filter)

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

FIR Digital Filters
Advantages and disadvantages of FIR over IIR filter, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters.
Location of the zeros of linear phase FIR filters.
Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann, Kaiser),
Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters. Gibbs phenomenon.
FIR filters realization using direct form, cascade form and linear phase form.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Finite Word Length effects in Digital Filters
Quantization, truncation and rounding, Effects due to truncation and rounding, Input quantization error, Product quantization error, Coefficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling. Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters.
Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

DSP Processors and Application
Introduction, Computer Architectures for signal processing, General purpose Digital signal Processors, selecting digital signal processors, Special purpose DSP Hardware, Architecture of TMS320C67X, Features of C67X processors, CPU, General purpose register files, Functional units and operation, Data paths, Control register file, Functional units, Internal memory, External memory, on chip peripherals, Interrupts, Instruction set and addressing modes, Fixed point instructions, Floating point instructions, Conditional operations, Parallel operations, Pipeline operations, Code Composer studio, Application programs in C67X.
Applications of Digital Signal Processing
Application of DSP for ECG signals analysis, Dual Tone Multi Frequency signal detection, Radar Signal Processing.

Text Books:
Text Books: 1. S. Salivahanan, “Digital Signal Processing”, McGraw Hill Education; 3rd edition, 2017. 2. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications (India) Pvt.Ltd., 6th edition, 2014. 3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing”, A Practical Approach by, Pearson Education 4. Tarun Kumar Rawat,Digital Signal Processing”, Oxford University Press, 2015.
Reference Books:
1. Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education. 2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited. 3. Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education. 4. B. Venkata Ramani and M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, McGraw Hill Second Edition. 5. L. R. Rabiner and B. Gold, “Theory and Applications of Digital Signal Processing”, Prentice-Hall of India, 2006. 6. TMS320C67XX User manual: www.ti.com .

Fiber Optic Communication
(Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Fiber Optic Communication**	**Short Title:**	**FOC**	**Course Code:**	

Course description:

This course provides knowledge about optical fiber technology that emerged as major innovation in telecommunication.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):

Knowledge of Light wave theory, Basic concept of analog and digital Communication

Course objectives:

The main objective of this course is

1. To introduce student with light ray theory of transmission and its application in optical communication.
2. To understand the construction of fiber and signal degradation in fiber.
3. To study various optical sources and optical detectors.
4. To understand Optical link design for fiber optics.
5. To study Optical Switching and networking technology concepts.

Course outcomes:

After successful completion of this course the student will be able to:

1. Able to know the fundamentals of Light theory and its application in optical communication.
2. Able to know the construction of various optical fiber and causes of signal degradation in fiber
3. Experience with the Knowledge of working of various optical sources and optical detectors.
4. Able to know about Optical link design for fiber optics.
5. Develop the knowledge on Optical Switching and networking technology.

COURSE CONTENT

Fiber Optic Communication		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Optical Fibers-Structures Wave guiding and Fabrication

Introduction to vector nature of light, Ray model, wave model**.** Block diagram of Optical communication system, Light system components, Optical transmitters, optical Receivers Advantage and Disadvantage of OFCS over other communication systems.

Ray theory of transmission and concept of acceptance angle and Numerical Aperture (Numerical based on Ray theory),

Propagation of light, Meridonial and skew propagation,

Wave theory of optical propagation: cut – off wavelength. Group velocity and Group delay. Fabrication methods of fibers –OVD, MCVD, VAD Process.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Optical Fibers and Signal Degradation Different types of optical fibers- Fiber profiles-Step index fibers, Graded index fibers Fiber modes –Optical modes Normalized frequency Single mode step index, Multimode step index, Multimode Graded index (Numerical on mode theory). **Signal degradation on optical fiber due to dispersion and attenuation.** Attenuation, Absorption, Absorption due to atomic defects, Extrinsic Absorption ,Intrinsic , Absorption ,scattering loss- Linear and Nonlinear loss, bending losses. Signal distortion in optical fiber: Information capacity determination, Material dispersion, waveguide dispersion, intermodal dispersion, Pulse broadening in Graded Index fiber (Numerical on pulse dispersion and pulse broadening)		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Optical Sources and Detectors **Sources :** Factors or Characteristics for their selection in OFCS, **Light Emitting diodes:** Surface emitter, LEDS, Edge emitter LEDS, LED operating Characteristics, Radiation patterns of surface and Edge emitters, **Laser diode:** Laser principles, semiconductor laser diode, Hetero junction Laser, stripgromentry lasers, laser diode. Detector parameters: Cutoff wavelength ,Quantum efficiency, Responsivity, speed of Response (Numerical based on detector parameter) **Detectors:** Characteristics or factors for their Selection, P-N photo diode, P-I-N Photo diode, Avalanche photodiode. (No Numerical on Detectors)		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Optical Receivers. Optical link design- Power budget, Rise time budget.(No Numerical) Sources of power penalties, Modal Noise, Dispersion Broadening, Mode partition noise, Frequency Chipring. BER calculation, Quantum limit.(Derivation not required and No Numerical) Fiber Splicing-Fusion Splicing, V-groove Splicing. Fiber Connectors- ST,SC,MTRJ(only Overview) **Optical Fiber Measurements:** Measurement of Attenuation, refractive index. Optical time domain reflectometry (OTDR).		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Advanced Optical Systems **Advanced Techniques:** Wavelength Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM). **WDM components**-2*2 Fiber Coupler, Star Coupler, Optical Isolator. **Optical amplifiers**,- Semiconductor Amplifier, Raman Amplifier, EDFA.		

Optical Networks- SONET (Synchronous Optical Network)-Transmission format and SONET Ring.
Text Books:
1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition). 2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975. 3. J. Gowar, Optical communication systems, Prentice Hall India, 1987. 4. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979. 5. Govind Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994. 6. Govind Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997 7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990). 8.Joseph C palais , Fiber optic Communication, Prentice Hall International Edition, Fourth Edition (1992)..
Reference Books:
1. John M. Senior , "Optical Fiber Communication (Principles & Practice)",Pearson Education.

<table>
<tr><td colspan="6">Speech And Audio Processing
(Professional Elective Course – III)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Speech And Audio Processing</td><td>Short Title:</td><td>SAP</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">1. Basic properties of audio and speech signals, Basic concepts and operations of audio signal processing, Introduction to acoustics and hearing;
2. Processing of digital audio signals, equalization, perceptual audio coding, sound synthesis.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

<table>
<tr><td>Prerequisite course(s):</td></tr>
<tr><td>Signals & Systems, Digital Signal Processing</td></tr>
<tr><td>Course objectives:</td></tr>
<tr><td>1. To be able to relate human physiology and anatomy with signal processing paradigms.
2. To acquire the knowledge of speech generation and speech recognition models.
3. To understand methods/techniques used in speech signal estimation & detection.</td></tr>
<tr><td></td></tr>
<tr><td>Course outcomes:</td></tr>
<tr><td>After successful completion of this course the student will be able to:</td></tr>
<tr><td>1. Mathematically model the speech signal .
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.
4. Summarize the various speech coding techniques.
5. Analyze application of speech processing in speech compression, speech recognition, and speech synthesis.</td></tr>
<tr><td>COURSE CONTENT</td></tr>
</table>

<table>
<tr><td colspan="2">Speech And Audio Processing</td><td>Semester:</td><td colspan="2">VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td colspan="2">End semester exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="2">Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
</table>

<table>
<tr><td>Unit–I: Speech Processing</td><td>No. of Lectures: 09 Hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">Speech Production and Modeling Human Auditory System; General structure of speech coders The process of speech production, Acoustic theory of speech production, Digital models of speech signals of speech signal.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Unit–II: Speech Analysis</td><td>No. of Lectures: 09 Hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">Time and frequency domain analysis of speech, Linear predictive coding (LPC) analysis, Cepstral analysis, Speech parameter (pitch) estimation. Speech Signal Processing.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Unit–III: Speech Synthesis	**No. of Lectures: 08 Hours**	**Marks: 12**
Principles of speech synthesis, Generic CELP encoders and decoders. Excitation code book search-state save method ,zero-input zero state method .CEPL based on adaptive codebook, Adaptive codebook search.		
Unit–IV: Coding of Speech and Quantization	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction, Scaler Quantization, uniform quantizer, logarithmic quantizer ,adaptive quantizer Speech redundancies, Vector quantization-distortion measures, codebook design, codebook types., Linear delta modulation, Adaptive delta modulation,		
Unit–V Audio Compression	**No. of Lectures: 08 Hours**	**Marks: 12**
Digital Audio, Lossy sound compression, μ-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.		
Text Books:		
1.“Digital Speech” by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004. 2. “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, W.C. Chu, WileyInter science, 2003. 3. “Digital Processing of Speech Signals”, Rabiner and Schafer, Prentice Hall, 1978.		
Reference Books:		
1. “Discrete-Time Speech Signal Processing: Principles and Practice”, Thomas F. Quatieri, Publisher: Prentice Hall. 2. “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, Nelson Morgan and Ben Gold, John Wiley & Sons. 3. “Speech and Audio Signal Processing”, Gold & Morgan, 1999, Wiley and Sons.		

Nano Electronics
(Professional Elective Course – III)

COURSE OUTLINE

Course Title:	**Nano Electronics**	**Short Title:**	**NE**	**Course Code:**	

Course description:

The rapid growth of the integrated circuit (IC) industry has led to the emergence of nano microelectronics process engineering as a new advanced discipline. Thus, there is a need to impart quality education at a sufficiently advanced level in the current state of art Nano electronics discipline

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Elements of Electrical and Electronics Engineering, CMOS Design, Electronics Devices.

Course objectives:

Nano Electronics course is designed to encompass all these aspects, viz., nano and micro regime design, simulation and fabrication and all types of IC's . It is expected that, after undergoing this course, the students will acquire both theoretical knowledge and practical skills in diverse upcoming areas of current technology and will be able to get into any one of these areas or be a bridge between these advanced areas to face the upcoming challenges and up-liftment of society.

Course outcomes:

After successful completion of this course the student will be able to:

1. Students will understand the divers electronic device fabrication.
2. Students will have in-depth technical knowledge in one or more areas of specialization.
3. Students will have practical understanding of the major engineering concepts and demonstrate application of their theoretical knowledge of the concepts and help to get the academic and industrial jobs.
4. Students will be able to interact scientifically with industry both within and outside of a Classroom setting.
5. Students will develop an appreciation of continuing educational and professional development.

COURSE CONTENT

Nano Electronics		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of

nano-photonics.		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists. Lithography based on Surface Instabilities: Wetting, De-wetting, Adhesion, Limitations, Resolution and Achievable / line widths etc. Lift off process, Bulk Micromachining.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity,Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor,Molecular SETs and Molecular Electronics.		
Text Books:		
1. Stephen D. Sentaria, *Microsystem Design, Kluwer Academic Press* 2. Marc Madou, *Fundamentals of microfabrication & Nanofabrication.* 3. T. Fukada & W.Mens, *Micro Mechanical system Principle & Technology, Elsevier, 1998.* 4. Julian W.Gardnes, Vijay K. Varda, *Micro sensors MEMS & Smart Devices, 2001.*		
Reference Books:		
1. Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springe 2. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill. 3. Spin Electronics by M. Ziese and M.J. Thornton 4. Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices by Karl Goser, Peter Glosekotter, Jan Dienstuhl		

5. Silicon Nanoelectronics by Shunri Odo and David Feny, CRC Press, Taylor & Franicd Group
6. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
7. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific.
8. James R Sheats and Bruce w.Smith, “Microlithography Science and Technology”, Marcel Dekker Inc., New York, 1998.
9. J.P. Hirth and G.M.Pound “Evaporation: Nucleation and Growth Kinetics” Pergamon Press, Oxford, 1963

Satellite Communication
(Professional Elective Course – IV)

COURSE OUTLINE

Course Title:	**Satellite Communication**	**Short Title:**	**SC**	**Course Code:**	

Course description:

This course describes the basics of Satellite communication to the undergraduate students. Satellite communications enable wireless communication in regions. The program gives you an in-depth understanding of the engineering aspects of these important current and future technologies

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	03

Prerequisite course(s): Advanced Digital Communication

Orbital Equations, Link Budget, Various Antennas and Various Architecture of Satellite System

Course objectives:

1. To study the basics concept of various satellite communication.
2. To Understand the principle and architecture of satellite communication.
3. To familiarize the concept of 2G,3G,4G and 5G system.
4. Provide strong foundation for understanding of Satellite Link Budget and various antennas.
5.To Learn the modern trends in Mobile Communication Engineering.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of satellite systems.
2. Analyze, test and use various link budget, power budget.
3. Describe the concept of 2G,3G,4G and 5G system.
4.Apply the concept for measurement of various parameters of C/N ratio.
5. To describe the modern trends in satellite communication engineering.

COURSE CONTENT

Satellite Communication		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Overview of Satellite Systems, Orbits and Launching Methods-Introduction – Frequency Bands used for Satellite Communication, Intelsat, Polar Orbiting Satellites. Kepler's First , Second and Third Law, Definitions of Terms for Earth orbiting Satellites – Orbital Elements – Apogee and Perigee Heights,Concept of Solar Day and Sidereal Day Orbital Perturbations, and sun-synchronous orbit

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Geostationary orbit, Wave Propagation and Polarization-Antenna look angles, antenna mount, limits of visibility, Earth eclipse of satellite, sun transit outage, launching of geostationary

satellites, Atmospheric losses, ionospheric effects, rain attenuation, Antenna polarization,polarization of satellite signals,cross polarization discrimination, Ionospheric depolarization rain depolarization, ice depolarization.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Satellite Antenna and Link Design-Overview of Satellite Link Budget, Antenna basics, aperture antennas. Parabolic reflectors, Offset feed, double reflector antenna, Introduction, equivalent isotropic radiated power, Transmission losses, The link power budget equation, System noise, carrier to noise ratio, The uplink & downlink, Effects of rain, combined Uplink and Downlink C/N ratio, Calculation in clear air and in rainy condition.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Wireless Communications and Modern Wireless Communications system-Evolution of Mobile radio communication, Mobile Radio systems around the world, wireless communication system, Trends in cellular radio and personal communications, Second generation(2G) cellular networks, Third generation(3G) wireless networks, Fourth generation(4G) wireless networks, Fifth generation(5G) wireless networks, wireless local loop(WLL) and wireless Local Area Networks(WLANs).		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cellular Concept and System Design Fundamentals, Wireless systems and Standards- Introduction, Frequency reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, Trucking and grade of service, Improving coverage and capacity in cellular systems, Global System for Mobile (GSM).		
Text Books:		
1. D. Roddy, “Satellite Communications”, Tata McGraw-Hill, 4th Edition, ISBN-0-07-007785-1 2. T. Rappaport, “Wireless Communications-Principles and Practice, 2nd Edition, ISBN-978-81-317-3186-4.		
Reference Books:		
1. Timothy Pratt Charles W Bostian, Jeremy E. Allnutt, “Satellite Communications”, Wiley India second edition 2002. 2. Tri T. Ha, “Digital Satellite Communications”, Tata McGraw-Hill,2009.		

Digital Image and Video Processing (Professional Elective Course – IV)					
COURSE OUTLINE					
Course Title:	Digital Image and Video Processing	**Short Title:**	DIVP	**Course Code:**	
Course description:					
To learn the basic principles and tools used to process images and videos, and how to apply them in solving practical problems of commercial and scientific interests.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):
Digital Communication, Signals & Systems, Digital Signal Processing
Course objectives:
1. Provide the student with the fundamentals of digital image processing. 2. Introduce the students to some advanced topics in digital image processing. 3. Give the students a useful skill base that would allow them to carry out further study in the field of Image processing.
Course outcomes:
After successful completion of this course the student will be able to:
1. Understand theory and models in Image and Video Processing. 2. Process these images for the enhancement of certain properties . 3. Develop algorithms for image compression and coding. 4. Apply quantitative models of image for various engineering applications 5. Understand theory and models in Video Processing.
COURSE CONTENT

Digital Image and Video Processing		**Semester:**	*VII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I: : Introduction	**No. of Lectures: 09 Hours**	**Marks: 12**
Digital Image Processing: Problems and Applications, Image representation and Modeling, Image Enhancement ,Image Analysis, Image Reconstruction from Projections and Image Data Compression..Basic relationship between pixels- neighborhood, adjacency, connectivity, distance measures.		
Unit–II: Image Perception	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction, Light luminance, brightness and contrast, MTF of the visual system, Monochrome Visual Model, Image fidelity criterion. Color image processing-,color models-RGB,YUV,HIS;. Color transformations, measures, Color image smoothing and sharpening. Color Segmentation-Image Segmentation.		
Unit–III: Image Sampling and Quantization	**No. of Lectures: 08 Hours**	**Marks: 12**
Image scanning, two dimensional sampling theory, extension of sampling theory, limitations in sampling and reconstruction, image quantization. Detection of discontinuities. Wavelets and multi-resolution image processing.		
Unit–IV: Image Transform	**No. of Lectures: 08 Hours**	**Marks: 12**
Two dimensional orthogonal and Unitary transform, Properties of unitary transform, The one dimensional discrete Fourier transform, , Wavelets and sub-band. Wavelet packets. Image compression-Redundancy-inter-pixel and psycho visual. Lossless compression-predictive, entropy. Lossy compression- Predictive and transform coding. Discrete Cosine transforms.		
Unit–V: Fundamentals of Video Coding	**No. of Lectures: 08 Hours**	**Marks: 12**
Inter-frame redundancy, motion estimation techniques, full search, fast search strategies. Predictive Techniques: Forward and backward motion prediction, Frame classification-I,P and B. Video coding standard-MPEG and H.26X Video segmentation-Temporal Segmentation.		
Text Books:		
1) Gonzalez and Woods, "Digital Image Processing", Pearson Education, 2) Arthur Weeks Jr., "Fundamentals of Digital Intake Processing", PHI. 3) S Jayaraman, “Digital Image Processing”, Tata McGraw Hill Publications. 4) 4. Anil Kumar Jain, "Fundamentals of Digital Image Processing"; Pearson Education 2nd edition 2015.		
Reference Books:		
1. Pratt William, "Digital Image Processing", John Wiley & Sons 2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Second Edition, Thomson Learning, 2001		

<table>
<tr><td colspan="6" align="center">Mixed Signal Design
(Professional Elective Course – IV)</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Mixed Signal Design</td><td>Short Title:</td><td>MSD</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course focuses on the concepts of mixed signal VLSI design. The course will give practical aspect of mixed signal VLSI blocks such as comparators, data converters, oscillators and phase locked loop. As a part of this course, the students will use industry standard softwares and tools such as Cadence's Virtuoso schematic, Spectre simulator and MentorGraphics' Eldo and Calibre for post layout simulations along with the parasitic extractions. The design problems given in the form of assignments will be designed and simulated in a standard CMOS technology by students. The study will cover design issues on the PVT variations and statistical mismatches in temperature and process (MonteCarlo). In summary, the course is designed with considering the need of VLSI design industry.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

Prerequisite course(s):

CMOS Design, VLSI

Course objectives:

To design and to implement the product level design blocks for VLSI applications.
1. To learn Switched Capacitor Circuits.
2. To learn advance design techniques for bandgap references, comparators, oscillators and PLL.
3. To understand data converter fundamentals DAC.
4. Learn Nyquist Rate A/D Converters
5. Understand oversampling converters, continuous time filters.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of Switched capacitors Circuits
2. Able to understand the design and application of PLLS.
3. To study concepts of Data Converter Fundamentals.
4. Understand the concepts of Nyquist Rate A/D Converters ,and applications
5. Understand concepts of the Oversampling Converters, Continuous-Time Filters , CMOS Trans conductors.

<table>
<tr><td colspan="4" align="center">COURSE CONTENT</td></tr>
<tr><td colspan="2">Mixed Signal Design</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td>End semester exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
</table>

		Internal Sessional Exams (ISE):	40 marks
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Switched Capacitor Circuits: Introduction to Switched Capacitor circuits basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, Biquad filters.			
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Phased Lock Loop (PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non idealities, Jitter in PLLs, Delay locked loops, applications.			
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Data Converter Fundamentals: DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters			
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**	
Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters. Electronics & Communication Engineering			
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**	
Oversampling Converters: Noise shaping modulators, Decimating filters and Interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A **Continuous-Time Filters:** Introduction to Gm-C Filters, Bipolar Trans conductors , CMOS trans conductors Using Triode and Active Transistors, Bi CMOS Tran conductors, MOSFET-C Filters.			
Text Books:			
1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002 2. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2013			
Reference Books:			
1. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience, 2009. 2. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010. **WEB REFERENCES** 1. NPTEL online courses.			

Artificial Intelligence & Machine Learning (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Artificial Intelligence & Machine Learning**	**Short Title:**	**AI-ML**	**Course Code:**	

Course description:

This course is to introduce the students to the fundamentals of Artificial Intelligence, Expert Systems and Neural Networks & Fuzzy logic and enable them to apply these concepts for solving real world problems.

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated system. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	

Prerequisite course(s):

Course objectives:

1. To understand the various characteristics of Intelligent agents.
2. To introduce students to the basic concepts and techniques of Neural Network.
3. To understand fundamental concept of Fuzzy Logic.
4. To introduce students to the basic concepts and techniques of Machine learning.
5. To gain skills for solving practical problems by machine learning.

After successful completion of this course the student will be able to:

Course Outcome :

1. Use appropriate search algorithms for any AI problem
2. Apply basic concept to describe neural network.
3. Apply basic knowledge to describe concept of Fuzzy logic.
4. Recognize the characteristics of machine learning that make it useful to real-world problems.
5. Able to use regularized regression and Classification algorithms.

COURSE CONTENT

Artificial Intelligence & Machine Learning		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Artificial Intelligence

Definitions of AI, History, Turing test, AI Problem and Techniques: Problem as State Space

Search, Problem characteristics, Production System: Water Jug problem. Knowledge Representation Issues, Knowledge Representation using Predicate Logic, Knowledge Representation using Rules .		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Neural Network Characteristics of Neural Networks: Features of Biological Neural Networks, Biological Neural Networks, Performance Comparison of Computer and Biological Neural Networks Artificial Neural Networks: Terminology, Models of Neuron: McCulloch-Pitts Model, Perception, Adeline Topology, Basic Learning Laws ,Learning Methods: Supervised and unsupervised, Introduction to Multilayer Perceptron, various activation functions.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Fuzzy Logic Introduction to fuzzy sets and fuzzy logic systems, Fuzzy set definitions, operations, Fuzzy rules, Fuzzy reasoning. Fuzzy inference systems, Fuzzy models.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Machine Learning: Types of Machine Learning Algorithms, Supervised Learning, Unsupervised learning, Reinforcement Learning, Classification of Machine Learning Concept, Distance Based Machine learning Methods, K-Nearest Neighbor (kNN). Introduction to Clustering Techniques, Possible Applications, Requirements of clustering algorithm, Problems associated with using Clustering Technique, Types of Clustering Methods, Clustering Strategies.		
.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Classification / Regression: Classifications, decision tree **learning**, naive bayes, linear regression, logistic regression, Linear regression models, support vector machine, beyond binary classifications: multiclass or multinomial classification.		
Text Books:		
1. Elaine Rich, Kevin Knight and Shivshankar Nair "Artificial Intelligence". 3rd Edition TMH. 2. V.K. Jain, Machine Learning, Khanna Publishing House. 3. Rajiv Chopra, Deep Learning. Khanna Book Publishing, New Delhi. 4. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI. 5. Rajasekaran and G.A. Vijayalakshmi, “Neural Networks, Fuzzy Logic, and Genetic Algorithms”, PHI .		
Reference Books:		
1. Rajiv Chopra, Machine Learning, Khanna Book Publishing, New Delhi. 2. Mitchell Tom, Machine Learning. McGraw Hill, 1997. 3. Ethem Alpaydin, Introduction to Machine Learning, PHI. 4. Timothy J Ross, “Fuzzy Logic with Engineering Application”, TMH. 5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007		

Big Data Analytics
(Open Elective Course – III)

COURSE OUTLINE

Course Title:	**Big Data Analytics**	**Short Title:**	**BDA**	**Course Code:**	

Course description:

Data Analysis is an ever-evolving discipline with lots of focus on new predictive modeling techniques coupled with rich analytical tools that keep increasing our capacity to handle big data.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Data Mining

Course objectives:

1. To understand the concepts of big data
2. To understand the concepts of Data science
3. To do the data analysis
4. To apply the concepts of data visualization
5. To apply data analytics tools

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the concepts of big data
2. Understand the concepts of Data science
3. Do the data analysis
4. Apply the concepts of data visualization
5. Apply data analytics tools

COURSE CONTENT

Big Data Analytics		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Big Data: Big data, 3V's, 4 V's of big data, Types of Big data, Analytics, Industry examples of Big data, Data risk, Big data technologies, Big data architecture, operational and analytical big data technologies, big data and eGovernance, Benefits of Big data, analytics and cloud computing, Crowd sourcing analytics.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Data Science: Data Science, Terminology Related with Data Science, Methods of Data Repository, Personnel Involved with Data Science, Types of Data, The Data

Science Process (DSP), Popular Data Science Toolkits, Familiarity with Example Applications		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Analysis: Introduction to Applied Statistical Techniques, Types of Statistical Data, Types Of Big Data Analytics, Collecting Data for Sampling and Distribution, Probability, Frequency Distribution, Population and Parameters, Central Tendency or Central Value, Measures Of Central Tendency, Different Types of Statistical Means, Problems of Estimation : Population or Sample, Normal Distribution Curve		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Data Visualization: Data Visualization, Importance of Data Visualization, Conventional Data Visualization Methods, Retinal Variables, Mapping Variables to Encodings, Case Study, Recent trends in various data collection and analysis techniques, Various Big Data Visualization Tools, Visualizing Big Data, Preattentive Attributes, Challenges of Big Data Visualization, Potential Solutions, Future Progress of Big Data Visualization		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Advanced Analytics: Technology and Tools: Hadoop: Architecture, components of Hadoop framework, Analysing big data with Hadoop. MapReduce: Overview, Map Operations, HIVE: features, architecture, working, data models. PIG: Introduction, components, pig vs MapReduce, Pig vs HIVE,		
Text Books:		
1. V.K.Jain, "Data Science and Analytics", Khanna Book Publishing Co.(P) LTD. Edition 2018 2. V.K.Jain, "Big Data and Hadoop", Khanna Book Publishing Co.(P) LTD. Edition 2017		
Reference Books:		
1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258. 2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication,ISBN: 978-1-118-16430-3 3. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X 4. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6 5. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893 6. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.		

Mechatronics (Open Elective Course – III)					
COURSE OUTLINE					
Course Title:	**Mechatronics**	**Short Title:**	**MTX**	**Course Code:**	
Course description:					
In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Course objectives:

1. To understand the concept and key elements of Mechatronics system, representation into block diagram
2. To understand principles of sensors their characteristics
3. To Understand of various data presentation and data logging systems
4. To Understand concept of actuator
5. To Understand various case studies of Mechatronics systems .

Course outcomes:

After successful completion of this course the student will be able to:

1. Identification of key elements of mechatronics system and its representation in terms of block diagram
2. Understanding basic principal of Sensors and Transducer.
3. Able to prepare case study of the system given.

COURSE CONTENT

Mechatronics		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Unit I :Introduction to Mechatronics

Basics of Mechatronics Systems : Definition of Mechatronics, Key elements of Mechatronics Systems, Levels of mechatronics systems, Measurement Characteristics, Examples of Mechatronics systems in daily life as ,Washing Machines, Digital Cameras, CD Players, camcorders, Mechatronics design process, phases of mechatronics design process,

integrated design approach.
Mechanical Components and Servo mechanism : Mechanical System and Motion, Mass Inertia and Dashpot, Gears, types of Gears, Servomechanism(Concepts and Theory, Problems).Case study Mechatronics Design of Coin Counter/Coin Separator
.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Overview of Sensors, Transducers and their Characteristics Specifications :
Classification and selection of transducers:
Force: Load Cell, Cantilever Beam (Design aspect example) **Pressure:** Strain Gauge, Piezoelectric **Motion:** Rotary and Linear motions, Proximity sensors Inductive, Capacitive and Magnetic, sources detectors in optical proximity sensors. Comparison of Various proximity sensors **Temperature:** Optical Fibre and its use in temperature measurement**,** Fibre Optic Temperature sensors, Ultrasonic Transducersfor applications as position, level, flow measurement. Gas sensors, Wind sensors: Gyroscope, Accelerometer, Magnetometer (As used in smart phones) **Smart Sensors**: Concept, Radiation Sensors - Smart Sensors - Film sensor, IR- temperature sensors Introduction to MEMS& Nano Sensors . Rotary Optical Encoder

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Hydraulic Systems
Introduction to Hydraulic Actuators Fluid Power systems, Concept of Actuators, Classification of Actuators: Pneumatic, Hydraulic and Electrical Actuators, Fluid Power systems.
Physical Components of a Hydraulic systems, Hydraulic Pumps (e.g. Gear Pumps, Vane Pumps, Piston Pumps and Axial Piston Pumps) , Filters and Pressure Regulation, Relief Valve, Accumulator. .

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Pneumatic Systems
Introduction to Pneumatic a Actuators Physical Components of a Pneumatic Systems, Pneumatic Cylinders, Pneumatic Actuators (e.g. Spring Actuator and Spring Actuator with positioner), Air compressor, Air Receiver, Air Dryer Air Service Treatment: Air Filter, air regulator and Gauge, Air Lubricator and Pressure regulation Intake and Air Filter. Case study of Robotic Pick and Place robot

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Electron-Mechanical Actuator:
Selection criteria and specifications of stepper motors, solenoid valves, relays (Solid State relays and Electromechanical relays). Selection Criterion of control valve, Single acting and Double acting Cylinders. Electro-Pneumatic: Pneumatic Motors, Valves: Electro Hydraulic: 3/2 Valves, 4/2 Valves, 5/3 Valves Cables: Power cable and Signal cables .
Boat Autopilot, High Speed tilting trains, Automatic car parking systems, Engine Management,

Antilock Brake systems (ABS) ,CNC Machines(Only Black Diagram and explaination)
Text Books:
1) W. Boltan ―Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Edition, Pearson Education, 2016 ‘ 2)David Alciatore and MaichaelB Histand, ―Introduction to Mechatronics and Measurement Systems,4th Edition, Tata McGraw Hill 2013.
Reference Books:
1) Nitaigour P. Mahalik , Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, Eleventh reprint 2011. 2) Devdas Shetty and Richard A.Kolk, ―Mechatronics System Design, Thomson India Edition 2007.

<table>
<tr><td colspan="6">Communication Lab-I</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Communication Lab-I</td><td>Short Title:</td><td>CL-I</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">The communication Lab –I is based on the application of optical fiber in communication system and Digital Image and Video Processing is described.</td></tr>
</table>

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Course objectives:

1. Student will understand the fundamentals and advantages in optical communication system.
2. Student will learn various types basic properties and transmission characteristic of optical fibers.
3. Student will learn working of optical transmission system with analog as well as digital data transmission.
4. Student will gain the knowledge of various losses in optical communication and apply the remedies to reduce losses.
5. To study the image fundamentals and mathematical transforms necessary for image processing.
6. To study the image enhancement techniques.
7. To study image restoration procedures.
8. To study the image compression procedures.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Able to know the fundamentals, advantages and advances in optical communication system.
2. Familiarize with types, basic properties and transmission characteristic of optical fibers.
3. Experience with the Knowledge of working of optical transmitter and the receiver with analog and digital data. Transmission.
4. Able to know various losses in optical communication and reduce the losses.
5. Review the fundamental concepts of a digital image processing system and analyze images in the frequency domain using various transforms.
6. Evaluate the techniques for image enhancement and image restoration.
7. Categorize various compression techniques and interpret Image compression standards.
8. Interpret image segmentation and representation techniques.

<table>
<tr><td colspan="4">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Communication Lab-I</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme:</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td>End Semester Exam (ESE): (PR)</td><td>25 marks</td></tr>
</table>

	Internal Continuous Assessment (ICA):	**25 marks**

(Note: Minimum EIGHT experiments to be performed from Group - A / Group - B)

Group - A

1. Electrical Characteristics of different type LED.
2. To study Laser Diode.
3. Photometric characteristics of LED/Laser Diode (Polar plot/Intensity Measurement)
4. NA Measurement for Single/Multi mode, Graded Index/Single Index optical Fiber
5. Attenuation Measurement and bending losses measurement of optical fiber
6. Spectral characteristics of LED/LD.
7. Analog Signal transmission using LED source.
8. Digital Signal transmission using LED source.
9. Study of OTDR
10. Study of optical connectors.

Group - B

1. Study of different file formats e.g. BMP, TIFF and extraction of attributes of BMP.
a. BMP.
b. TIFF and extraction of attributes of BMP.
2. Study of statistical properties- mean, standard deviation, profile, variance and Histogram plotting.
a. Study of statistical properties-mean, standard deviation and profile.
b. Study of statistical properties- variance and Histogram plotting.
3. Histogram equalization and modification of the image.
a. Histogram equalization of the image.
b. modification of the image.
4. Gray level transformations such as contrast stretching, negative, power law transformation.
a. Contrast Stretching, negative.
b. Power Law Transformation.
5. Spatial Domain filtering- smoothing and sharpening filters.
a. Spatial Domain filtering- smoothing filters.
b. Spatial Domain filtering- sharpening filters.
6. DCT / IDCT of given image.
a. DCT of given image.
b. IDCT of given image.
7. Edge detection using Sobel, Prewitt and Roberts operators.
a.Edge detection using Sobel,Prewitt operators.
b.Edge detection using Roberts operators.
8. Capturing image through grabber card from camera and Process it.
9. Application Development
a. Biometric Authentication such as Face / Finger Print / Signature Recognition.
b.Human Expression Detection.
10. Creating noisy image and filtering using MATLAB.

Text Book
1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition). 2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975. 3. J. Gowar, Optical communication systems, Prentice Hall India, 1987. 4. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979. 5. Govind Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994. 6. Govind Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997. 7. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009. 8. S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009.
Reference Books:
1.John M. Senior , "Optical Fiber Communication (Principles & Practice)",Pearson Education. 2. Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd,Third Edition 3. S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012. 4. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.
Guide lines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

<table>
<tr><td colspan="6">Digital Signal Processing Lab</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Digital Signal Processing Lab</td><td>Short Title:</td><td>DSPL</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Digital Signal Processing Lab objectives is practical implementation of the convolution, correlation, DFT, IDFT, Block convolution, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals</td></tr>
</table>

<table>
<tr><td rowspan="2">Laboratory</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester credits</td></tr>
<tr><td>2</td><td>14</td><td>28</td><td>1</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="3">Practical (PR)</td></tr>
<tr><td colspan="5">Prerequisite course(s):</td></tr>
<tr><td colspan="5">Signal and System</td></tr>
<tr><td colspan="5">Course objectives:</td></tr>
<tr><td colspan="5">1. Design and implement a DSP system using tools like MATLAB
2. Analyze and describe the functionality of a real world DSP system
3. Work in teams to plan and execute the creation of a complex DSP system
4. Apply DSP system design to real world applications and demonstrate Finite word length effect.
5. To study the architecture of DSP processor.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Course outcomes:</td></tr>
<tr><td colspan="5">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="5">1. Understand the handling of discrete/digital signals using MATLAB
2. Understand the basic operations of Signal processing
3. Analyse the spectral parameter of window functions
4. Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters.
5. Design the signal processing algorithm using MATLAB</td></tr>
<tr><td colspan="5"></td></tr>
</table>

<table>
<tr><td colspan="4">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Digital Signal Processing Lab</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme:</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td>End Semester Exam (ESE): (PR)</td><td>25 marks</td></tr>
<tr><td colspan="2"></td><td>Internal Continuous Assessment (ICA):</td><td>25 marks</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">(Note: Minimum EIGHT experiments to be performed)
1. To find DFT / IDFT of given DT signal
2. Implementation of FFT of given sequence
3. Determination of Power Spectrum of a given signal
4. Implementation of LP and HP FIR filter for a given sequence</td></tr>
</table>

5. Implementation of LP and HP IIR filter for a given sequence
6. Implementation of Decimation Process
7. Implementation of Interpolation Process
8. Implementation of I/D sampling rate converters
9. To study the effect of different windows on FIR filter response.
10. Design Butterworth filter using bilinear transformation method for LPF.
11. Study of Code Composer Studio to demonstrate / implement DFT / IDFT
12. Study of Code Composer Studio to demonstrate / implement FFT /IIT

Text Books:

1. S. Salivahanan, “Digital Signal Processing”, McGraw Hill Education; 3rd edition, 2017.
2. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publications (India) Pvt.Ltd., 6th edition, 2014.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing”, A Practical Approach by, Pearson Education
4. Tarun Kumar Rawat,Digital Signal Processing”, Oxford University Press, 2015.

Reference Books:

1. Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education.
2. Sanjit K. Mitra , Digital Signal Processing – A Computer Based Approach – 4th Edition McGraw Hill Education (India) Private Limited.
3. Oppenheim A., Schafer R., Buck J., "Discrete Time Signal Processing", 2nd Edition, Pearson Education.
4. B. Venkata Ramani and M. Bhaskar, “Digital Signal Processors, Architecture, Programming and Applications”, McGraw Hill Second Edition.
5. L. R. Rabiner and B. Gold, “Theory and Applications of Digital Signal Processing”, Prentice-Hall of India, 2006.
6. TMS320C67XX User manual: www.ti.com .

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Project (Stage – I)					
LAB COURSE OUTLINE					
Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	
Course description:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	12	**14**	**168**	**6**
End Semester Exam (ESE) Pattern:		**Oral (OR)**		
Prerequisite course(s):				

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT			
Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Practical:	**12 hours/week**	**End Semester Exam (ESE): OR**	**50 marks**
		Internal Continuous Assessment (ICA):	**50 marks**

At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project must be practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data, conduction of experiments and analysis etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design, analysis and fabrication. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract
Chapter 1. Introduction

- Background / Literature Survey.
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis

- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)

- Summary

Chapter 4. Design
- System Architecture and Design Methodology.
- Circuit Diagram and Data Flow Diagram / Flow chart.
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Result, Conclusion & Future Work

Bibliography

Index

Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:
Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:
Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.

11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering
(Electronics and Telecommunication Engineering)
Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ

अंतरी पेटवू ज्ञानज्योत

1990

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS
Semester – VIII
W.E.F. 2020 – 21

<table>
<tr><td colspan="6">Computer Network</td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Computer Network</td><td>Short Title:</td><td>CN</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">This course describes the basics concept of Computer Network, architecture, protocol and its Applications.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	13	42	

Prerequisite course(s): Analog & Digital Communication, Signal and System

Course objectives:

1. To study the basics concept of Computer Network.
2. To Understand the principle of various types of Computer Network.
3. To familiarize the concept of Various Protocols.
4. Provide strong foundation for understanding of Congestion and Quality of Service.
5.To Learn the Network Security & Authentication Protocols.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts of Computer Network systems.
2. Analyze various types of noisy protocols.
3.Describe the concept of circuit switching and packet switching.
4.Apply the concept for Congestion control and techniques to improve quality of service.
5. To describe the modern trends in Network Security and Public Key Algorithm.

COURSE CONTENT

Computer Network		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Computer Network –Network Topologies, Network components: Hubs & switches, LAN,MAN,WAN, ISO/OSI Reference Model, TCP/IP Reference Model, Guided and unguided media: Transmission media: Twisted pair, coaxial cable, Fiber optics. Wireless Transmission: Radio transmission, Microwave transmission, Infrared Transmission, ISDN: Narrowband ISDN: ISDN services, System architecture, Interface. Broadband ISDN, ATM reference model.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Data Link Layer-Design issues, Framing, Error and Flow Control Flow control, Data Link Protocols: Unrestricted Simplex Protocol, stop and wait protocol, Simplex Protocol for a Noisy Channel. Sliding Window Protocols: One bit sliding window, Using Go-Back n, Protocol using Selective Repeat, HDLC, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access,

CSMA,CSMA/CD,CSMA/CA		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Network Layer -Design Issue of Network Layer, Comparison of Virtual circuit and Datagram subnets, Routing Algorithms, Shortest Path Routing, Flooding, Hierarchical Routing, Broad Cast Routing, Multicast routing, Congestion Control Algorithms, Congestion Prevention Policies, Choke Packets, Internet Protocol: Internetworking, IPV4 Datagram, IPV6 Addresses		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transport Layer -ARP,RARP, ICMP,IGMP, Transmission Control Protocol(TCP), User Datagram Protocol(UDP) , Congestion Control of Transport Layer, Quality of Service(QoS), Techniques to improve QoS, Remote Procedure Call		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Application Layer- Domain Name System(DNS), SNMP, Network Security, Cryptography, Public key algorithms, Digital Signature, Authentication Protocols, Firewalls, Time division switching, Space division switching.		
Text Books:		
1. Andrew S Tanebaum - Computer Networks, 4th Ed. PHI/ Pearson education. 2. Behrouz A Forouzan - Data Communication and Networks, 3rd Ed. TMH.		
Reference Books:		
1. Irvine Olifer - Computer Networks: Principles, Technology and Protocols, Wiley India. 2. William Stalling – Data and Computer communications, 7th Ed. PHI 3. S. Keshav ,"An Engineering Approach to Computer Networking", Pearson Edu.		

Microwave Theory and Techniques
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Microwave Theory and Techniques**	**Short Title:**	**MTT**	**Course Code:**	

Course description:

This course is designed to lay the foundation of microwave theory. The various modes of propagations through wave guides are included. Students will become familiar with the usage of active and passive components of microwave systems. Measurements of various parameters of microwave systems and Modern trends of microwave engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s):

Electromagnetic theory, Wave propagation, Antennas and Semiconductor physics

Course objectives:

1. To study the basics concept of various mode of propagation in waveguide.
2. To Understand the fundamentals of microwave passive components.
3. To familiarize the concept of microwave active devices.
4. Provide strong foundation for understanding of microwave measurement and microwave antenna.
5. To Learn the modern trends in microwave Engineering.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of microwave systems.
2. Analyze, test and use various passive microwave components for different applications.
3. Describe the concept of microwave active tubes.
4. Apply the concept for measurement of various parameters of microwave system.
5. To describe the modern trends in microwave engineering.

COURSE CONTENT

Microwave Theory and Techniques		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; General Application of Microwave, Advantages-Rectangular, Circular, & Disadvantages. Types of waveguide, Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Mathematical derivation of TEM Mode, TM Mode, TE Mode, Cut off frequency ,Phase velocity, Group Velocity ,Guide wavelength, wave Impedance for rectangular waveguide.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Passive Microwave Devices- Microwave passive components: E Plane Tee, H- Plane Tee Magic Tee, Directional Coupler, Analysis with S Matrix ,Attenuator, Frequency meter, Ferrite Devices-Isolator, circulator, Microwave filters, Matched Terminations, waveguide Bends, Twist		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Active Microwave Devices: Microwave tubes: Klystron, TWT, Backward Wave Oscillator, Magnetron. Gunn Diodes, Tunnel diode, PIN diodes, Varactor diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microwave Measurements: Frequency-Electronics Method, Mechanical Method, Power, VSWR, attenuation, Impedance measurement. **Microwave Antennas:** Fundamental parameters of antennas**,** Horn antenna, Parabolic reflector with all types of feeding methods, slotted antenna, Lens antenna,		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Modern Trends in Microwaves Engineering Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication , RF MEMS for microwave components, **Microwave Systems** Wireless Communications system, Radar Systems, Radiometer Systems,		
Text Books:		
1. Samuel Liao, Microwave Devices and Circuits, Pearson Education, 3/e. 2. Annapurna Das, Sisir Das, Microwave Engineering, TMH, 3/e		
Reference Books:		
1. Robert E Collin, Foundations for Microwave Engineering, Wiley India, 2/e. 2. Sisodia, Gupta, Microwaves: Introduction to Circuits, Devices and Antennas, New Age, 1/e. 3. Manojit Mitra, Microwave Engineering, Dhanpat Rai, 3/e.		

Adaptive Digital Signal Processing
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Adaptive Digital Signal Processing**	**Short Title:**	ADSP	**Course Code:**	

Course description:

Adaptation is accomplished by adjusting the free parameters of a filter according to the input data to achieve the desired output. Such adaptive algorithms are frequently encountered in many signal processing and machine learning algorithms. The adaptive signal processing course provides a comprehensive treatment of mathematical signal processing algorithms for designing optimum and linear filters; designing, implementing, and analyzing adaptive filters applied to system identification, inverse modeling (deconvolution), adaptive control, and interference cancellation; and some selected emerging topics in signal processing.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	*14*	*40*	3

Prerequisite course(s):

Signal and System , Digital Signal Processing

Course objectives:

To provide rigorous foundations in multirate signal processing, power spectrum estimation and adaptive filters.
1. To understand Linear Prediction and Optimum Linear Filters.
2. Learn Algorithms for Adapting FIR Filters.
3. Learn Algorithms for Adapting IIR Filters.
4. Understand Frequency-Domain and Subband Adaptive Filter.
5. Learn Kalman Filters.

Course outcomes:

After successful completion of this course the student will be able to:

1. To Analyze and implement Wiener filters
2. To Analyze and implement LMS and normalized LMS Adaptive filters signals.
3. To Analyze and implement frequency domain Adaptive filters
4. To Analyze and implement Recursive Adaptive filters
5. To apply adaptive signal processing to various applications

COURSE CONTENT

Name of the Subject		**Semester:**	*FILL HERE*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Linear Prediction and Optimum Linear Filters

Signals,Correlation Functions and Power Spectra,Innovations Representation of a Stationary Random Process,Forward and Backward Linear Prediction,Solution of Normal Equations,Properties of Linear Prediction –Error Filters,AR Lattice and ARMA Lattice-Ladder Filters,Wiener Filters for filtering and Prediction

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Algorithms for Adapting FIR Filters

Search Techniques, Gradient search Approach,Least Mean Square Algorithm,Recursive Least Squres Algorithms

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Algorithms for Adapting IIR Filters

IIR Modeling,Gradient Descent Minimization of squared Prediction Error,Parameter Identification format and Stability theory Interpretation,Filtered Error and Filtered-Regressor Algorithms,Steiglitz-McBridge Algorithm,IIR whitner,ARMAX modeling

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Frequency-Domain and Subband Adaptive Filters

Block Adaptive Filters,Fast Block-LMS algorithm,Unconstrained Frequency-Domain Adaptive Filters,Self-Orthogonalising Adaptive Filters,Adaptive Equalization,Subband Adaptive Filters,Classification of Adaptive Filtering Algorithms

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Kalman Filters

Innovations Process, Estimation of the State Using the Innovations Process Kalman Filter as the Unifying Basis for RLS filters,Variations of the Kalman Filter, Applications

Text Books:

1. S.Haykin,”Adaptive Filter Theory”,Pearson,2003
2. B.Widrow and S.D.Stearns,”Adaptive Signal Processing”, Pearson,2009

Reference Books:

1.J.Treichler,C.R.Johnson,M.G.Larimore,”Theory and Design of Adaptive Filters”,PHI,2002
2.J.G.Proakis,D.G.Manolakis,”Digital Signal Processing:Principles,Algorithms, and Applications”,2011
3. D.G.Manolakis, V. K. Ingle, and S. M. Kogon ,”Statistical and Adaptive Signal Processing”, McGraw-Hill,2005
4. S.L.Marple,”Digital Spectral Analysis”,1987.
5. M.H.Hays,” Statistical Digital Signal Processing and Modeling”, John-Wiley,2001.

Antenna and Wave Propagation
(Professional Elective Course – V)

COURSE OUTLINE

Course Title:	**Antenna and Wave Propagation**	**Short Title:**	**AWP**	**Course Code:**	

Course description:

The objective of this course is to provide an in- depth understanding of modern antenna concepts, and practical antenna design for various applications. The course will explain the theory of different types of antennas used in communication systems
Lecture

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s): Advanced Digital Communication

The course requires knowledge about fundamental antenna theory and advanced electromagnetic field theory. The following experience is useful: understating vector calculus, some knowledge of Maxwell's equations, electrical engineering principles.

Course objectives:

1. To study the basics concept of Antenna and Wave Propagation.
2. To Understand the principle and radiation pattern of Antenna.
3. To familiarize the concept of Huygens Principle &Babinet Principle.
4. Provide strong foundation for understanding of Smartantennas.
5.To Learn the modern trends inAntenna and Wave Propagation& different modes of radio propogation used in current practice.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of Antennasystems.
2. Analyze, test and use various types of radiation pattern of antenna.
3.Describe the concept of Huygens Principle &Babinet Principle..
4.Apply the concept for measurement of various parametersof Antennas.
5. To describe the modern trends in different modes of radio propogation& Smart Antennas benefits used in current practice.

COURSE CONTENT

Satellite Communication		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Antenna Fundamental Concepts-Definitions – Radiation intensity – Directive gain – Directivity – Power gain – Beam width – Band width – Gain and radiation resistance of current element – Half-wave dipole and folded dipole – Reciprocity principle – Effective length and effective area, Relation between gain, effective length and radiation resistance. Physical concept

of radiation, Radiation pattern, near- and far-field regions, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Antenna Arrays, Radiation from Wires and Loops-Antenna array concept, Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Aperture Antennas-Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts. Broadband Antennas: Broadband concept, Log-periodic antennas, frequency independent antennas.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microstrip Antennas-Concept, Advantages and disadvantages, Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Wave Propagation -The three basic types of propagation: Ground wave, space wave and sky wave propagation. Sky Wave Propagation: Structure of the ionosphere – Effective dielectric constant of ionized region – Mechanism of refraction – Refractive index – Critical frequency – Skip distance – Effect of earth‘s magnetic field – Energy loss in the ionosphere due to collisions – Maximum usable frequency – Fading and diversity reception. Space Wave Propagation: Reflection from ground for vertically and horizontally polarized waves – Reflection characteristics of earth – Resultant of direct and reflectedray at the receiver – Duct propagation. Ground Wave Propagation: Attenuation characteristics for ground wave propagation – Calculation of field strength at a distance.		
Text Books:		
1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons., 2005. 2. Antennas And Wave Propagation by: K.D.PRASAD		
Reference Books:		
1. Harish A. R., Antenna and wave propagation, Oxford University Press. Tri T. Ha, "Digital Satellite Communications",Tata McGraw-Hill,2009 2. J.D.Kraus,"Antennas,McGraw-Hill,1988		

Embedded System
(Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**Embedded System**	**Short Title:**	**ES**	**Course Code:**	

Course description:
To provide students with basic knowledge and skills in embedded systems design.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	*14*	*42*	*3*

Prerequisite course(s):

Digital System Design, Microcontrollers

Course objectives:

1. To understand advance trends in embedded system
2. To acquaint students with knowledge of embedded processor, its hardware and software.
3. To provide skills in embedded C programming and interfacing with Embedded processor.
4. To understand real time operating systems, inter-task communication and embedded software development tools.
5. Learn the internet operated system and market new trends and technology.

Course outcomes:

After successful completion of this course the student will be able to:

1. Distinguish real-time embedded systems from other systems.
2. Understand the ARM processor fundamentals.
3. Design Real World Interfacing with ARM7 Based Microcontroller
4. Evaluate the need for real-time operating system and real-time algorithm for task scheduling.
5. Understand the IoT and its application design.

COURSE CONTENT

Embedded System		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Embedded System Introduction
Definition, Embedded Systems Vs General Computing Systems, Classification, categories, Characteristics, Recent Trends , quality attributes (Design Metric),embedded product development life cycle (EDLC), communication protocols like CAN, bluetooth and Zig-bee.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

ARM Processors
Introduction to ARM processors and its versions, ARM7, ARM9 & ARM11 features, advantages

& suitability in embedded application. Introduction to Tiva TM4C123G Series Overview, Programming model, Tivaware Library
ARM7 : registers, CPSR, SPSR, ARM and RISC design philosophy, ARM7 data flow model, programmers model, modes of operations.
ARM7 Based Microcontroller LPC2148: Features, Architecture (Block Diagram and Its Description) , System Control Block (PLL and VPB divider) , Memory Map, GPIO, timer,

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Real World Interfacing with ARM7 Based Microcontroller
Programming in assembly language/ Embedded C, Interfacing with LED, LCD, GLCD, KEYPAD, stepper / dc motor , simple LPC2148 GPIO Programming examples Using timers of LPC2148 to generate delay, Interrupt structure of LPC2148, programming for UART
on-chip devices ADC, DAC,WDT,USB,PWM.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Real Time Operating System Concept
Types of OS, Tasks, process, Threads, Multiprocessing and ,Multitasking, Task scheduling, Threads, Process , Scheduling ,Task communications, Task synchronization, how to choose RTOS, Overview of operating system (off-the-shelf, Embedded, RTOS, Handheld), Introduction to JAVA Programming for Embedded System
Introduction to Ucos II RTOS and it's features, study of kernel structure of Ucos II.
Case study of digital camera and automatic chocolate vending machine (without codes)

Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**

Internet of Things(IoT)
Introduction to IoT, Sensing, Actuation, Basics of Networking, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, Interoperability in IoT,
Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.
Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT.
Case Study: Smart Cities and Smart Homes, Smart Grid, Agriculture, Healthcare, Activity Monitoring.

Text Books:

1. Embedded Systems, Rajkamal , TMH, 2008.
2. Shibu. K. V, "Introduction to Embedded Systems", Tata Mcgraw Hill, 2009.
3. Frank Vahid - Embedded Systems , Wiley India, 2002
4. Jean J Labrose - MicroC / OS-II, Indian Low Price Edition 2002
5. DR.K.V.K.K. Prasad - Embedded / real time system, Dreamtech
6. Iyer, Gupta - Embedded real systems Programming , TMH
7. Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W. Valvano; Cengage Learning; Third or later edition.
8. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

9. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press).
Reference Books:
1. Embedded systems software primer, David Simon - Pearson 2. ARM System Developers Guide- Sloss, Symes, Wright, ElsevierMorgan Kaufman, 2005 3. ARM System-on-Chip Architecture, Steve Furber - Pearson 2005 4. LPC 214x User manual (UM10139) :- www.nxp.com 5. ARM architecture reference manual : - www.arm.com 6. Trevor Martin,‖An Engineer‘s Introduction to the LPC2100 series‖, Hitex (UK) 7. Joseph Yiu, ―The Definitive Guide to the ARM Cortex-M‖, Newness, ELSEVIER. 8. http://www.ti.com/

Mobile Communication Network (Professional Elective Course – VI)					
COURSE OUTLINE					
Course Title:	**Mobile Communication Network**	**Short Title:**	**MCN**	**Course Code:**	
Course description:					
.This course describes the fundamentals of telecommunication switching and their traffic. This course will help to understand the concept of mobile management and coding in GSM & CDMA.					

Mobile Communication Network	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Knowledge of basic Computer Networking and their concept.

Course objectives:

1. To learn and understand the basic principles of Telecommunication switching, traffic and networks
2 To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
3To learn and understand architecture of GSM and CDMA system.
4 To understand mobile management, voice signal processing and coding in GSM and CDMA system

Course outcomes:

After successful completion of this course the student will be able to:

After successfully completing the course students will be able to
1 Explain and apply the concepts telecommunication switching, traffic and networks
2 Analyze the telecommunication traffic.
3 Analyze radio channel and cellular capacity.
4 Explain and apply concepts of GSM and CDMA system

COURSE CONTENT			
Mobile Communication Network		**Semester:**	
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09Hours**	**Marks: 12**

Telecommunication Switching & Traffic

Telecommunication switching: Message switching, Circuit switching, Manual System, Electronic Switching. Digital switching: Switching functions, Telecommunication Traffic: Unit of Traffic, Traffic measurement, A mathematical model, Lost- call systems: Theory, traffic performance, loss

systems in tandem, traffic tables. Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, Systems with a single server, Queues in tandem, delay tables and application of Delay formulae		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Switching Networksand Signaling		
Single Stage Networks, Gradings, Link Systems, Grades of service of link systems. Time Division Switching: Space and time switching, Time division switching networks, Synchronization, Call processing Functions, Common Control, Reliability, Availability and Security. Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling principles, CCITT signaling No. 6, CCITT signaling No. 7, Digital customer line signaling		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Cellular Concepts		
Evolution of Wireless systems, Introduction to cellular telephone system, Frequency reuse, Channel Assignment, Handoff strategies, Cell Splitting, Propagation Mechanism: Free space loss, Reflection, Diffraction, Scattering. Fading and Multipath: Small scale multipath propagation, Impulse response model of multipath channel. Multiple Access Techniques-TDMA, FDMA, CDMA		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
First and Second Generation Mobile Systems		
First Generation Cellular Systems, AMPS, GSM Cellular Telephony: Introduction, Basic GSM Architecture, Basic radio transmission parameters in GSM system, Logical Channels, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover, Modifications and derivatives of GSM.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
GSM Services , GSM Physical layer		
Speech Coding and decoding, GMSK modulation, Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE. CDMA Based Mobile Systems Motivation for CDMA use, Spreading Sequences, Basic Transmitter and Receiver schemes, IS-95 system: Frequency Range, Downlink transmission, Uplink transmission, Power control, Introduction to 3G mobile systems: W-CDMA and cdma-2000		
Text Books:		
1. J. E. Flood , “Telecommunications Switching, Traffic and Networks”, Pearson Education 2. Krzysztof Wesolowski, “Mobile Communication Systems”, Wiley Student Edition		
Reference Books:		
1. Theodore S Rappaport, “Wireless Communications Principles and Practice” Second Edition, Pearson Education 2. John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications 3. ThiagarajanVishwanathan, “Telecommunication Switching Systems and Networks”; PHI Publications 4. Wayne Tomasi, “Electronic Communications Systems”; 5th Edition; Pearson Education .		

High Speed Electronics
(Professional Elective Course – VI)

COURSE OUTLINE

Course Title:	**High Speed Electronics**	**Short Title:**	**HSE**	**Course Code:**	

Course description:

The course aims to give exposure on the band diagram, characteristics of hetero-junction devices and fabrication techniques.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	*14*	*42*	*3*

Prerequisite course(s):

BEEE, Semiconductor Devices

Course objectives:

As semiconductor device geometry miniaturizes, the device becomes faster and some devices move into the quantum-effect region. These higher-speed devices are the key components for future electronic systems in communications, computers, control, and consumer applications.
1. Important parameters governing the high speed performance of devices and circuits.
2. To understand material properties.
3. To learn MOS diode, MOSFET, structure and operations.
4. To learn Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices.
5. To learn High Electron Mobility Transistors.

Course outcomes:

After successful completion of this course the student will be able to:

1. Knowledge of materials and basic issues (compound semiconductor) used in high speed devices and their
2. Properties related to the high speed and devices
3. Knowledge of the advanced technologies, devices operation along with their descriptive models for high speed electron devices
4. Basic knowledge of the operation of selected optoelectronic devices and to exploit small-signal equivalent circuit models of high frequency electron devices (MESFETs, HEMTs, HBTs)
5. Ability to exploit physics-based mathematical models for the analysis and the design of high frequency electron devices (MESFETs, HEMTs, HBTs)

COURSE CONTENT

High Speed Electronics		**Semester:**	*VIII*
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Important parameters governing the high speed performance of devices and circuits:

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Materials properties: Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
MOS Diode: Structure - band diagram - operation - C–V characteristics - effects of oxide charges - avalanche injection - high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation - I–V and C–V characteristics (analytical expressions) - MOSFET breakdown and punch through - subthreshold current - scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors		
Text Books:		
1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley 2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related		

Compounds, John Wiley & Sons 3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985 4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992. 5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5
Reference Books:
1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5 2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12- 691740-X 3. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007,ISBN 978-0-86341-743-6. 4. Ruediger Quay, Gallium Nitride Electronics, Springer 2008, ISBN 978-3-540-71890-1, (Available on NITC intranet in Springer eBook section) 5. Prof. Dr. Alessandro Birolini, Reliability Engineering Theory and PracticeSpringer 2007, ISBN-10 3- 540- 40287-X, Available on NITC intranet in Springer eBook section)

Automotive Electronics and Electric Vehicle
(Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Automotive Electronics and Electric Vehicle**	**Short Title:**	**AEEV**	**Course Code:**	

Course description:

The objective of this course is to provide an in- depth understanding of modern **Automotive** Electronics & Electric vehicle concepts, and various types of sensors used in automobile vehicles.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	13	42	

Prerequisite course(s): Instrumentation, Microprocessor & Microcontroller and Digital Signal Processing.

The course requires knowledge about fundamental of motors, sensors,controllers, signal processors and electric vehicles containing 2 stroke & 4 stroke engine.

Course objectives:

1. To study the basics concept of sensors& actuators.
2. To understand the principle of various motors & signal processors.
3. To familiarize the concept of Hall Effect Sensors & combustion engine.
4. Provide strong foundation for understanding of Smartelectric vehicles.
5.To Learn the modern trends inhybrid engine vehicles & electronically controlled automotives.

Course outcomes:

After successful completion of this course the student will be able to:

1 Describe the basic concepts and applications of varioussensors.
2. Analyze, test and use various types of test benches for electric vehicles.
3.Describe the concept of CI & PIengines.
4.Apply the concept for measurement of various parametersof vehicles.
5. To describe the modern trends in different smart electronically controlled hybrid vehicles.

COURSE CONTENT

Automotive Electronics and Electric Vehicle		**Semester:**	**VIII**	
Teaching Scheme:		**Examination scheme**		
Lectures: 03	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Use of Electronics In The Automobile -Concept of A System, Control Theory: Open Loop Control & Close loop control, Instrumentation, Signal Processing & Filtering, Electronics Fundamentals, Instrumentation application of Microcomputer

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Electronic Engine Control -Motivation For Electronic Engine Control, Concept of An Electronic Engine Control System, Engine Performance Terms, Electronic Fuel Control System, Analysis of Intake Manifold Pressure, Idle speed control, Electronic Ignition

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sensors and Actuators -Automotive Control System Applications of Sensors And Actuators, Throttle Angle Sensor, Temperature Sensors, Sensors For Feedback Control: Knock Sensor, Automotive Engine Control Actuators, Electric Motor Actuator, Ignition System & Coil operation		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Hybrid Electric Vehicles -Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Energy Storage - Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE).		
Text Books:		
1. William B. Ribbens – Understanding Automotive Electronics-An Engineering Perspective, Butterworth-Heinemann, An imprint Elsevier, First Indian reprint 2014, ISBN 978-93-5107-1518 2. Al Santini- Automotive Technology, Cengage Learning, India Edition, 2011, ISBN 978-81-3151412-2. 3. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.		
Reference Books:		
1. K. K. Ramalingam- Automobile Engineering, Scitek Publication, Second Edition. J.D.Kraus,”Antennas, McGraw-Hill,1988. 2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015. 3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004. 4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.		

Cyber Security
(Open Elective Course – IV)

COURSE OUTLINE

Course Title:	**Cyber Security**	**Short Title:**	**CS**	**Course Code:**	

Course description:

Cyber Security course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

Computer Network

Course objectives:

1. To understand Cybercrime and Cyberoffenses.
2. To understand Cybercrime through portable devices.
3. To understand tools and methods used in Cybercrime.
4. To understand Phishing and Identity theft.
5. To understand Computer Forensics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Determine the act of Cyberoffenses.
2. Determine the Cybercrime through portable devices.
3. Determine the methods used in Cybercrime.
4. Determine Phishing and Identity theft.
5. Describe Computer Forensics.

COURSE CONTENT

Cyber Security		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes

Cyberoffenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft) **Understanding Computer Forensics:** Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics		
Text Books:		
1. Nina Godbole and Sunil Belapure, “Cyber Security”, Wiley India Publication, 2014		
Reference Books:		
1. Nina Godbole , Information Systems Security , Wiley India Publication 2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition		

Robotics **(Open Elective Course – IV)**					
COURSE OUTLINE					
Course Title:	**Robotics**	**Short Title:**	**RO**	**Course Code:**	
Course description:					
In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):
Course objectives:
1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming.
Course outcomes:
After successful completion of this course the student will be able to:
1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics

COURSE CONTENT			
Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to Robotics: Robots, History of Robots, Robots Usage, Basic Structure of Robots, Classification of Robots by Applications, classification by Coordinate Systems, Classification by Actuation System, Classification by Control System, Robot classification by programming method.		

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Robot Actuators, Sensors and Vision: Robot Actuators: Pneumatic , Hydraulic and Electric Robot Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection Vision System in Robots.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Transformations and Statics in Robotics: Robot Architecture, Pose of Rigid Body, Coordinate Transformation, Denavit and Hartenberg(DH) Parameters Forces and Moment balance, Recursive Calculations, Equivalent Joint Torque, Role of Jocobian in Statics.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Kinematics and Dynamics Forward Position Analysis, Inverse Position Analysis, Velocity Analysis, Inerita Properties, Eular- Lagrange Formulation, Newton – Eular Formulation, Recursive Newton – Eular Algorithm		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Robotic Control and Programming: Control Techniques, Second Order Linear Systems, Feedback Control and its Performance, Non Linear Trajectory Control, State Space Representation and Control, Stability, Cartesian and Force Controls, Robotic Programming		
Text Books:		
1. Saha, S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.		
Reference Books:		
1. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, PHI, New Delhi. 2. Mittal R.K. and Nagrath I.J., “Robotics and Control”, Tata McGraw Hill. 3. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi. 4. Craig, J.J., “Introduction to Robotics: Mechanics and Control”, Pearson, New Delhi, 2009. 5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modelling and Control”, John Wiley and Sons Inc, 2005. 6. Steve Heath, “Embedded System Design”, 2nd Edition, Newnes, Burlington, 2003.		

<table>
<tr><td colspan="6" align="center">Communication Lab-II</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Communication Lab-II</td><td>Short Title:</td><td>CL-II</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">The communication Lab –II is based on Microwave theory and Technique and Embedded System.</td></tr>
</table>

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Electromagnetic Wave and Microcontroller

Course objectives:

1. To understand Analysis of Waveguides and gain complete knowledge about Microwave Components.
2. Design of Impedance Matching and Tuning using lumped and distributed elements for network.
3. To Analysis and study characteristics of microwave tube Generators and Amplifiers.
4. To Analysis and study characteristics of microwave Semiconductor of detector, switch, generator
5. Introduce students to embedded systems design tools and hardware programmers
6. Give the students skills in both simulation and practical implementation of the basic building blocks of a ARM including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, serial communications.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Understand various parameters of waveguide and use of component as per applications.
2. Able to design impedance matching network for any transmission line or system.
3. Able to analyze and find applications and limitations of microwave tube Generators and Amplifiers.
4. Able to analyze and find applications and limitations of microwave Semiconductor devices.
5. Able to understand basics of embedded system.
6. Understand the use of IDE tools
7. Understand the interfacing of basic I/O devices like LED, LCD, 7-Segment
8. Able to interface switch, stepper motor and implement RTOS behavior.

<table>
<tr><td colspan="4" align="center">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Communication Lab-II</td><td>Semester:</td><td align="center">VIII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme:</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td>End Semester Exam (ESE): (PR)</td><td>25 marks</td></tr>
<tr><td colspan="2"></td><td>Internal Continuous Assessment (ICA):</td><td>25 marks</td></tr>
</table>

(Note: Minimum EIGHT experiments to be performed from Group - A / Group - B)

Group - A

1 Plot and study V-I Characteristics of GUNN Diode
2 Plot and study Reflex Klystron Characteristics
3 Measurement of Attenuation (Fixed and Variable)
4 Microwave Junction: Power splitting Characteristics (E / H/ EH plane tee)
5 Measurement of coupling factor, insertion loss, directivity and isolation of Directional coupler
6 Study of Circulators (Y or T Type) and Isolators (measurement of isolation)
7 Measurement of VSWR (using Vmax / Vmin method)
8 Plot radiation pattern of horn antenna.
9 Plot radiation pattern of parabolic antenna.
10 Measurement of unknown impedance using smith chart

Group - B

1. Study of IDE (integrated development environment)
2. C-Program to explore timers / counter.
3. C-programs for interrupts.
4. Program to interface LED and switch.
5. Program to interface LCD.
6. Program to interface Keyboard and display key pressed on LCD.
7. Program to interface stepper motor.
8. Writing basic C-programs for I / O operations.
9. Implementation of USB protocol and transferring data to PC.
10. Implementation of algorithm /program for the microcontroller for low power modes.

Text Book

1. Samuel Liao, Microwave Devices and Circuits, Pearson Education, 3/e,
2. Annapurna Das, Sisir Das, Microwave Engineering, TMH, 2/e
3. David M. Pozar, Microwave Engineering, Wiley India, 4/e
4. Sisodia, Gupta, Microwaves : Introduction to Circuits, Devices and Antennas, New Age, 1/e.
5. Rajkamal - Embedded Systems, TMH, Second edition
6. Andrew sloss " Arm System Developer guide"
7. Data sheet and User manual of LPC2148.
8. Dr.K.V.K.K. Prasad - Embedded / real time system, Dreamtech.

Reference Books:

1. Manojit Mitra, Microwave Engineering, Dhanpat Rai, 3/e
2. Robert E Collin, Foundations for Microwave Engineering, Wiley India, 2/e
3. Simon Ramo, Fields and Waves in Communication Electronics, Wiley India, 3/e
4. K K Sharma, Fundamentals of Microwave and Radar Engineering, S Chand. 1/e
5. Steve Furber - ARM System-on-Chip Architecture, Pearson
6. Jean J Labrose - MicroC / OS-II, Indian Low Price Edition

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

<table>
<tr><td colspan="6">Computer Network Lab</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Computer Network Lab</td><td>Short Title:</td><td>CNL</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6"></td></tr>
</table>

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

<table>
<tr><td>End Semester Exam (ESE) Pattern:</td><td>Practical (PR)</td></tr>
<tr><td colspan="2">Prerequisite course(s):</td></tr>
<tr><td colspan="2">Computer Fundamental and Basics of Analog and Digital Communication</td></tr>
<tr><td colspan="2">Course objectives:</td></tr>
<tr><td colspan="2">1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Course outcomes:</td></tr>
<tr><td colspan="2">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="2">1. Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Identify the different types of network devices and their functions within a network</td></tr>
<tr><td colspan="2"></td></tr>
</table>

<table>
<tr><td colspan="4">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Computer Network Lab</td><td>Semester:</td><td>VIII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme:</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td>End Semester Exam (ESE): (PR)</td><td>25 marks</td></tr>
<tr><td colspan="2"></td><td>Internal Continuous Assessment (ICA):</td><td>25 marks</td></tr>
<tr><td colspan="4"></td></tr>
</table>

(Note: Minimum EIGHT experiments to be performed)

1. Study of different types of Network cables and Practically implement
2. The cross-wired cable and straight through cable using clamping tool.
3. Study of Network Devices in Detail.
4. Study of network IP.
5. Connect the computers in Local Area Network.

6. Performing an Initial Switch Configuration
7. Configuration of Router and Study of Routing between LANs.
8. Implementing an IP Addressing Scheme
9. Observing Static and Dynamic Routing
10. Configuring Ethernet and Serial Interfaces
11. Performance of CDMA
12. Three node point to point network
13. Transmission of Ping messages
14. Implementation of LAN using Multiuser Windows operation system.

Text Books:

1. Andrew S Tanebaum - Computer Networks, 4th Ed. PHI/ Pearson education.
2. Behrouz A Forouzan - Data Communication and Networks, 3rd Ed. TMH.

Reference Books:

1. Irvine Olifer - Computer Networks: Principles, Technology and Protocols, Wiley India.
2. William Stalling – Data and Computer communications, 7th Ed. PHI
3. S. Keshav ,"An Engineering Approach to Computer Networking", Pearson Edu.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

<table>
<tr><td colspan="8" align="center">Project</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td colspan="2">Project</td><td>Short Title:</td><td>PROJ</td><td colspan="2">Course Code:</td><td></td></tr>
<tr><td colspan="8">Course description:</td></tr>
<tr><td colspan="8">Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.</td></tr>
<tr><td rowspan="2">Laboratory</td><td>Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="3">Semester credits</td></tr>
<tr><td>6</td><td>14</td><td colspan="2">84</td><td colspan="3">3</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="5">Oral (OR)</td></tr>
<tr><td colspan="8">Prerequisite course(s):</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course objectives:</td></tr>
<tr><td colspan="8">1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course outcomes:</td></tr>
<tr><td colspan="8">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="8">1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE CONTENT</td></tr>
<tr><td colspan="3">Project</td><td colspan="2">Semester:</td><td colspan="3">VIII</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="5">Examination scheme:</td></tr>
<tr><td rowspan="2">Practical:</td><td colspan="2" rowspan="2">6 hours/week</td><td colspan="4">End semester exam (ESE): (OR)</td><td>50 marks</td></tr>
<tr><td colspan="4">Internal Continuous Assessment (ICA):</td><td>50 marks</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.</td></tr>
</table>

It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the complete project report is as follows.

Abstract
Chapter 1. Introduction
- Background / Literature Survey
- Motivation
- Problem Definition
- Scope
- Objective
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management
- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Analysis
- Requirement Collection and Identification
- H/w and S/w Requirement (Data, Functional and Behavioral)
- Functional and non-Functional Requirements
- Software Requirement's Specification (SRS)
- Summary

Chapter 4. Design
- System Arch
- Circuit Diagram and Data Flow Diagram
- UML Diagrams (Use case, Class, Sequence, Component, Deployment, State chart, Activity diagram etc.)
- Summary

Chapter 5. Coding/Implementation
- Algorithm/Steps

- Software and Hardware for development in detail
- Modules in Project

Chapter 6. Testing
- Black Box/White Box testing
- Manual/Automated Testing
- Test Cases Identification and Execution (Test case ID, Input, Output, Expected Output, Actual Output, Result (Pass/Fail) etc.)

Chapter 7. Results and Discussion

Chapter 8. Conclusion & Future Work

Bibliography

Index

Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Fourth Year Engineering

(Mechanical Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII &VIII

W.E.F. 2021 – 22

Subject Group Code and Subject Groups

Sr. No.	**GROUP**	**Category**	**Breakup of Credits (Total 171)**
1	**A**	Humanities and Social Sciences including Management Courses (HSMC)	**10**
2	**B**	Basic Science Courses (BSC)	**26**
3	**C**	Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computer etc. (ESC)	**26**
4	**D**	Professional Core Courses (PCC)	**53**
5	**E**	Professional Elective Courses relevant to chosen specialization/branch (PEC)	**18**
6	**F**	Open subjects – Electives from other technical and /or emerging subjects (OEC)	**12**
7	**G**	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad (PROJ)	**15**
8	**H**	Mandatory Courses (MC) [Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
		Total	**160**

Kavayatri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering (Mechanical Engineering) Faculty

of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

Syllabus Structure & Contents of Fourth Year of Engineering

Semester-VII

w.e.f. 2021 – 2022

Syllabus Structure for Fourth Year Engineering (Semester – VII) (Mechanical Engineering) (w.e.f. 2021 – 22)AICTE

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Design of Machine Elements	**D**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Professional Elective Courses – III	**E**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Professional Elective Course – IV	**E**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Open Elective Course – III	**F**	**3**	**--**	**--**	**3**	40	60	-	-	100	**3**
Design of Machine Elements Lab	**D**	**--**	**--**	**2**	**2**	--	--	25	25 (OR)	50	**1**
Computer Aided Design Lab	**D**	**1**	**--**	**2**	**3**	--	--	25	25 (PR)	50	**2**
Project (Stage – I)	**G**	**--**	**--**	**12**	**12**	--	--	50	50 (OR)	100	**6**
Essence of Indian Traditional Knowledge	**H**	**--**	**--**	**--**	**--**	-	-	--	--	--	**0**
		13	**--**	**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III	Professional Elective Course – IV	Open Elective Course – III
1) Automation in Manufacturing	1) Mechatronic Systems	1) Machinery Condition Monitoring
2) Operation Research	2) Advanced Machining Processes	2) Data Base Management
3) Electrical & Hybrid Vehicles	3) Power Plant Engineering	3) Microprocessor & Microcontrollers in automation
4) Mechanical Vibration	4) Product Design	4) Research Methodology

Syllabus Structure for Fourth Year Engineering (Semester – VIII) (Mechanical Engineering) (w.e.f. 2021 – 22)AICTE

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Refrigeration & Air Conditioning	**D**	3	--	--	3	40	60	--	--	100	**3**
Professional Elective Course – V	**E**	3	--	--	3	40	60	--	--	100	**3**
Professional Elective Course – VI	**E**	3	--	--	3	40	60	--	--	100	**3**
Open Elective Course – IV	**F**	3	--	--	3	40	60	-	-	100	**3**
Refrigeration & Air Conditioning Lab	**D**	--	--	2	2	--	--	25	25 (OR)	50	**1**
Finite Element Analysis & Simulation Lab	**D**	2	--	2	4	--	--	25	25 (PR)	50	**3**
Project	**G**	--	--	6	6	--	--	50	50 (OR)	100	**3**
		14	**--**	**10**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V	Professional Elective Course – VI	Open Elective Course – IV
1) Robotics 2) 3D printing 3) Renewable Energy Sources & Technology 4) Design of Transmission System	1) Total Quality Management 2) Automobile Engineering 3) Computational Fluid Dynamics 4) Gas Dynamics & Jet Propulsion	1) Entrepreneurship, Innovations & Startups 2) Industrial & System Engineering 3) Internet of Things 4) Artificial Intelligence

DESIGN OF MACHINE ELEMENTS					
COURSEOUTLINE					
Course Title:	**Design of Machine Elements**	**Short Title:**	**DOME**	**Course Code:**	

Course Description:

This course aims to equip the mechanical engineering students with the fundamentals of design activities and give them necessary skills to prepare complete, concise, and accurate calculation steps for machine elements. While the first part of the machine elements covering general stress analysis, failure conditions, shaft, spring, permanent and nonpermanent joints design, rolling contact and journal bearings, gears, clutches, flywheels, etc.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	03	14	42	03

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

1. To understand procedure of machine design and develop an ability to apply it for simple component design by using design data hand book.
2. To understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure
3. To determine forces on transmission shaft and design of transmission shaft
4. To determine the endurance strength and design of components subjected to fluctuating loads
5. To determine the forces in welds and bolt joints and formulate design solution for size of weld and size of bolt
6. To study standard procedure of bearing selection from manufacturing catalogue

Course Outcomes:

After successfully completion of this course students will be able to:

1. apply knowledge of the stress and strain of mechanical components; and understand, identify and quantify factor of safety, failure modes for simple mechanical components (Shaft and Coupling) subjected to direct and bending and combined loading.
2. develop logical and analytical ability to apply knowledge of various theories of failures for design of joints, bolts, springs etc.
3. the selection of gear types, sizing, analysis and material selection of spur and helical gear systems.
4. the selection of gear types, sizing, analysis and material selection of bevel and worm gear systems.
5. estimate endurance strength of ductile and brittle materials and develop analytical ability to apply fatigue theories for ductile and brittle material in static and dynamic loading.

COURSE CONTENT			
Design of Machine Elements		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**

	Duration of ESE:	**03 hours**
	Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Introduction and Design of Shaft and coupling	**No. of Lectures: 08 hours**	**Marks: 12**
Introduction of Machine Design, Basic procedure of Machine Design, Requisites of design engineer, Sources of design data, Design considerations - limits, fits and standardization, Selection of preferred sizes, Stress concentration - causes and remedies, Review of failure theories for static loading. Shafts: - Material, Design on the basis of strength considering shaft subjected to, twisting moment only, bending moment only, combine twisting and bending moment. A.S.M.E. code for shaft design. Couplings: - Design considerations, Classification, Design of Flange coupling and Flexible bushed pin coupling.		
Unit – II: Design of Joints, Spring	**No. of Lectures: 08 hours**	**Marks: 12**
Threaded Joints: - Stresses in threaded joint, Bolts of uniform strength, eccentrically loaded bolted joint, Torque requirement for bolt tightening. Welded Joints: - Types of welding and joints, strength of transverse and parallel fillet welded section, eccentrically loaded joint. Spring: - Types, Applications and materials of springs, Stress and deflection equations for helical springs, Style of ends, Wahl's Stress Factor, Design of helical compression and tension springs, leaf spring, nipping, Shot peening		
Unit – III: Design of Spur Gear and Helical Gear	**No. of Lectures: 09 hours**	**Marks: 12**
Spur Gears: Number of teeth and face width, Type of gear tooth failure, Desirable properties and selection of gear material, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength equation, Estimation of module based on beam and wear strengths, Estimation of dynamic tooth load by velocity factor and Buckingham's equation, Helical Gears: Transverse and normal module, Virtual number of teeth, Force analysis, Beam and Wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.		
Unit – IV: Design of Bevel Gears and Worm Gear	**No. of Lectures: 09 hours**	**Marks: 12**
Bevel Gears Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears, Selection of material for bevel gears, Worm Gear Worm and worm gear terminology and geometrical relationship, Standards dimension, Force analysis of worm gear drives, Friction in worm gears and its efficiency, Worm and worm-wheel material, Beam strength and wear strength of worm gears, Methods of Gears lubrication		
Unit – V: Design of Bearings and Design for Fluctuating Loads	**No. of Lectures: 08 hours**	**Marks: 12**

Rolling contact Bearings: Type of rolling contact bearing, Static and dynamic load carrying capacities, Striback's equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Selection of rolling contact bearings from manufacturer's catalogue. Design for cyclic loads and speed, bearing with probability of survival other than 90%. Design for Fluctuating Loads: Fluctuating stresses, Fatigue failure, Endurance limit, Reversed stresses, Solderberg and Goodman diagrams
Text Books:
1. Bhandari V.B., "Design of Machine elements", Tata McGraw Hill Pub. Co. ltd. 2. Farzdak Haideri, "Machine Design", Nirali Prakashan, Pune 3. R. B. Patil, "Mechanical System Design" Techmax publications; 4th edition (2018)
Reference Books:
1. Shigley J.E., Mischke C.R., "Mechanical Engineering Design" McGraw Hill Pub. Co. Ltd. 2. Spott's M. F., Shoup T. E. "Design of Machine Elements", Prentice Hall International. 3. "Design Data", P.S.G. College of Technology, Coimbatore. 4. Juvinal R. C. "Fundamental of Machine Component Design", John Wiley and sons. 5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

<table>
<tr><td colspan="6" align="center">AUTOMATION IN MANUFACTURING</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6" align="center">COURSE OUTLINE</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Course Title:</td><td>Automation in Manufacturing</td><td>Short Title:</td><td>AM</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course Description:</td></tr>
<tr><td colspan="6">Automation in manufacturing is key to success in cost cutting of manufacturing and material handling.</td></tr>
</table>

<table>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester Credits</td></tr>
<tr><td>3</td><td>14</td><td>42</td><td>3</td></tr>
</table>

Pre-requisite Course(s):

English

Course Objectives:

The objectives of this course is to introduce the main principles of automation, to generate knowledge and skills of students to use automation systems and devices for the implementation of it in manufacturing industry.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Understand production systems and elements of automated system.
2. Understand types of material handling and identification technologies.
3. Identify the components of manufacturing and assembly lines.
4.Understand role of cellular manufacturing;
5. Learn various low-cost automation systems

<table>
<tr><td colspan="4" align="center">COURSE CONTENT</td></tr>
<tr><td colspan="2">Automation in Manufacturing</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination Scheme:</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td>End Semester Exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="2"></td><td>Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
</table>

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Over View of Manufacturing and Automation: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

Material Handling and Identification Technologies: Material handling, equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID.

Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual

Assembly lines, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Automated Assembly Systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, hybrid systems, comparative evaluation.		
Text Books:		
1. Modern Machining Process, Pandey and Shan, TMH Manufacturing Automation 2. Automation, production systems and computer integrated manufacturing/ Mikell. P Groover/PHI/3rd edition/2012. 3. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/2003.		
Reference Books:		
1. G. Pippengerm, Industrial Hydraulics, MGH, New York, 1979. 2. F. Kay, Pneumatics for Industry, The Machining Publishing Co., London, 1969. 3. A. Ray, Robots and Manufacturing Assembly, Marcel Dekker, New York, 1982. 4. System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96 5. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009 6. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/Willcox Publishers 7. Metal Cutting Mechanics, Machine Tool Vibrations, CNC Design, Yusuf, Cambridge University Press		

<table>
<tr><td colspan="6">Operations Research</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Operations Research</td><td>Short Title:</td><td>O.R.</td><td>Course Code:</td><td>FILL HERE</td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">Operations research (OR) have many applications in science, engineering, economics, and industry and thus the ability to solve OR problems are crucial for both researchers and practitioners. Being able to solve the real-life problems and obtaining the right solution requires understanding and modelling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. The goal of this course is to teach you to formulate, analyze, and solve mathematical models that represent real-world problems.</td></tr>
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<table>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester credits</td></tr>
<tr><td>3</td><td>14</td><td>42</td><td>3</td></tr>
</table>

<table>
<tr><td>Prerequisite course(s):</td></tr>
<tr><td>Familiarity with linear algebra is required.</td></tr>
<tr><td>Course objectives:</td></tr>
<tr><td>Students to use quantities methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.</td></tr>
<tr><td></td></tr>
<tr><td>Course outcomes:</td></tr>
<tr><td>After successful completion of this course the student will be able to:</td></tr>
<tr><td>1. Use methods of the graph in solving linear program and to find the optimal solution
2. Use the method simplex and to find the optimal solution.
3. Build and solve Transportation Models and Assignment Models.
4. Describe the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.
5. Build and solve Replacement Models and Sequencing Models.</td></tr>
<tr><td></td></tr>
</table>

<table>
<tr><td colspan="4">COURSE CONTENT</td></tr>
<tr><td colspan="2">Operations Research</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td>End semester exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
<tr><td>Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
</table>

<table>
<tr><td>Unit–I:</td><td>No. of Lectures: 08 Hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">Operation Research – An Introductions
The history of OR, Definition, Features, of OR, models and modelling in OR, OR approach to problem solving, methods for solving OR models, phases of OR, Advantages of OR study, Shortcomings of OR approach, OR Models in Practice, Applications of OR.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Unit–II:</td><td>No. of Lectures: 10 Hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">Linear Programming- Introduction, general Stricture of LP model, Assumption of an LP model, Advantages and Limitations of Linear programming, Applications areas of LP, steps</td></tr>
</table>

of LP Model formulation, Graphical solution methods of LP problem, maximization, minimization, feasible, infeasible and unbounded solution.
The simplex method Introduction, standard form of an LP problem, simplex algorithm (maximization, minimization case) Degeneracy in simplex problem, unbounded Infeasible solution.
Duality in Linear programming, formulation of dual LPP, Advantages of duality, rules for constructing the Dual from primal, sensitivity Analysis in LP

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Transportation problem introduction, mathematical model of transportation problem, Algorithm, methods for finding initial solution northwest corner method, least cost method, Vogel’s Approximation method, test for optimality steps of MODI method, maximization problem, unbalanced, degeneracy, prohibited transportation Routes problem.
Assignment problem- introduction, mathematical models of assignment problem, solution method of assignment problem, Hungarian method, maximization case, unbalanced Restrictions on assignment, travelling salesman, problem.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Decision Theory- Introduction, steps in decision making process types of decision-making Environments, Decision tree.
Theory of games- introduction, Two-person Zero sum game, pure strategies, maximin, minimax principles, game with saddle point, mixed strategy games, The principles of dominance, games without saddle point, algebraic method, arithmetic method, sub game method, Graphical method.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Replacement and maintenance method- Introduction, types of failure- gradual failure, sudden failure Replacement of items whose efficiency deteriorates with time, Replacement of items that completely fail, individual replacement policy, Group replacement policy, staffing problem, failure trees.
Sequencing problem- Introduction notations, Terminology, and assumptions of sequencing problem, Processing n jobs through two machines, Processing n jobs through three machines, Processing n jobs through four machines, Processing n jobs through five machines Graphical method.

Text Books:

1. Gupta, P.K. and Hira, D.S. (2008) Operations Research. S. Chand and Company Limited, New Delhi.
2. S. D. Sharma, “Operation Research”, Khanna Publication
3. Manohar Mahajan, “Operation Research”, Dhanpat Rai and Co.

Reference Books:

1. Taha, “Introduction to Operations Research.” PHI Publications.
2. J. K. Sharma, “Operation Research, Problem and Solution”, Macmillan
3. N. D. Vohra, “Quantitative Techniques in Management”, TATA McGraw Hill
4. Ravindran, “Operation Research Principles and Practice”, Wiley India Pvt. Ltd. New Delhi
5. Wayne L. Winston, “Practical Management Science: Spreadsheet modelling and applications”, Duxbury Press,

ELECTRICAL AND HYBRID VEHICLES

COURSEOUTLINE

Course Title:	**Electrical and Hybrid Vehicles**	**Short Title:**	**EHV**	**Course Code:**	

Course Description:

This course will provide you with a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s):

Basics of electrical and electronics engineering, Control Systems Engineering, Electrical Machines

Course Objectives:

1. To study the concepts and drive train configurations of electric drive vehicles
2. To provide different electric propulsion systems and energy storage devices
3. To explain the technology, design methodologies and control strategy of hybrid electric vehicles
4. To emphasize battery charger topologies for plug in hybrid electric vehicles

Course Outcomes:

After successfully completion of this course students will be able to:

1. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
2. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
3. Choose proper energy storage systems for vehicle applications.
4. Identify various communication protocols and technologies used in vehicle networks.
5. Understand energy management strategies.

COURSE CONTENT

Electrical and Hybrid Vehicles		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives. Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies		
Text Books:		
1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011. 2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.		
Reference Books:		
1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010. 2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000 3. http://nptel.ac.in/courses/108103009/		

MECHANICAL VIBRATION					
COURSEOUTLINE					
Course Title:	**Mechanical Vibration**	**Short Title:**	**MV**	**Course Code:**	
Course Description:					
This course introduces undergraduate students to Mechanical Vibration. The background required includes a sound knowledge of Mathematics (Calculus), Engineering Mechanics, Strength of materials and Theory of mechanics of second year and Third year Level. The course aims at imparting knowledge of Mechanical vibration.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	14	42	3

Pre-requisite Course(s): Mathematics (Calculus) at First year level and strength of Materials, Theory of Machines at Second year Level.

Course Objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To analyse oscillatory motion of dynamic systems and the forces associated with the motion.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Determine the natural frequency of Fundamental of Vibrations & Undamped Free Vibrations.
2. Analyze the Damped Free &Forced Vibrations of Single Degree of Freedom Systems.
3. Compute the natural frequencies Two Degree of Freedom Systems.
4. Select the numerical methods to determine Multi Degree of Freedom Systems Exact Analysis.
5. Describe the vibration measurement Continuous Systems & Non-Linear Vibrations

COURSE CONTENT

Mechanical Vibration		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

FUNDAMENTAL OF VIBRATIONS- Introduction, Definitions, Vector method of representing harmonic motions, Addition of two simple harmonic motions of the same frequency, Beat phenomenon, Complex method of representing harmonic vibrations, Work done by a harmonic force on a harmonic motion. UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS - Introduction, Derivation of differential equation, Solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method.

Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**
DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS- Introduction, Different types of damping's, Free vibrations with viscous damping, Logarithmic decrement. Viscous dampers, Dry friction or coulomb damping, Solid or structural damping, Slip or interfacial damping. FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS- Introduction, forced vibrations with constant harmonic excitation, Forced vibrations with rotating and reciprocating unbalance, Forced vibrations due to excitation of support. Vibration isolation and transmissibility.		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
TWO DEGREE OF FREEDOM SYSTEMS- Introduction, Principal modes of vibration, Other cases of simple two degree of freedom systems, Combined rectilinear and angular modes. System with damping, Undamped forced vibrations with harmonic excitation, Vibration absorbers.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
MULTI DEGREE OF FREEDOM SYSTEMS EXACT ANALYSIS- Introduction, Free vibrations equations of motion, Influence coefficients, Generalized coordinates and coordinate coupling. Natural frequencies and mode shapes, Forced vibrations by N's second law of motion, Torsion vibrations of multi-rotor systems. MULTI DEGREE OF FREEDOM SYSTEMS NUMERICAL METHODS- Introduction, Rayleigh's method, Dunkerley's method, Stodola's method.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
CONTINUOUS SYSTEMS- Vibrations of strings, Longitudinal vibrations of bars, Torsional vibrations of circular shafts, Lateral vibrations of beams. NON-LINEAR VIBRATIONS- Introduction, Examples of non-linear systems, Phase plane, Undamped free vibration with nonlinear spring forces, Pertubation method, Forced vibration with non-linear spring forces, Self-excited vibrations.		
Text Books:		
1. V. P. Singh, "Mechanical Vibrations", Dhanpat Rai & Co. (P) Ltd., Delhi 2. G. K. Grover "Mechanical Vibrations", New Chand & Bros Roorkee (U.P.)		
Reference Books:		
1. Dilip Kumar Adhwarjee "Theory and Applications of Mechanical Vibrations", Laxmi Publications (p) Ltd., New Delhi 2. Leonard Meirovitch "Element of Vibration Analysis" Tata McGraw-Hill Publishing Company Limited, New Delhi 3. Singiresu S. Rao "Mechanical Vibrations", Pearson Education Ptd. Ltd., Delhi 4. S. Graham Kelly "Schaum's Outlines Mechanical Vibrations", Tata McGraw-Hill Publishing Company Limited, New Delhi 5. B. H. Tongue," Principles of Vibration", 2/ed. Oxford University Press, New Delhi		

MECHATRONIC SYSTEMS

COURSEOUTLINE

Course Title:	**Mechatronic Systems**	**Short Title:**	**MS**	**Course Code:**	

Course Description:

Mechatronics is a multi-disciplinary study dealing with the integration of mechanical devices, actuators, sensors, electronics, intelligent controllers and computers. Many new generations of consumer or commercial products can be classified as mechatronic products as they involve mechanical as well as electronic components.

	Hours/week	**No. of weeks**	**Total hours**	**Semester Credits**
Lecture	3	14	42	3

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

(i) To understand the structure of microprocessors and their applications in mechanical devices
(ii) To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
(iii) To understand the use of micro-sensors and their applications in various fields

Course Outcomes:

Upon completion of this course, students will be able to:
1. Understand how different physical variables are measured and illustrate their working principles
2. Identify and select proper sensors and transducers for specific applications
3. Understand issues of implementation of MEMS & Touch sensors
4. Understand different types of actuators and their implementation
5. Design the pneumatic and hydraulic system.

COURSE CONTENT

Mechatronic Systems		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Fundamentals of Mechatronics	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach. Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology

Unit – II: Sensors and Transducers	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction, Significance of Sensor Measurements, Classification of Sensors, Analog vs Digital Sensors

Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. **Dynamic Characteristics:** Sensor bandwidth and frequency response **Signal conditioning:** Amplifier, Conversion, Filtering, Impedance Buffering Types of errors, Effect of component errors, Probable errors. Selection criteria of sensors for mechatronic systems. Sensors**:** Displacement and Position Sensors, Velocity, Force, Motion and Pressure Sensors, Temperature and Light Sensors,		
Unit – III: MEMS and Touch sensors	**No. of Lectures: 08 hours**	**Marks: 12**
MEMS Sensors: Micro Electro Mechanical System (MEMS) Sensors, Working Principle, MEMS accelerometers, MEMS gyroscopes, MEMS pressure sensors, MEMS magnetic field sensors, Advantages, Applications, Air Bag Crash Sensors, Antilock Brake System, Active Suspension System, **Touch Sensors:** Working Principle, capacitor Type Touch Sensors, Resistive Touch sensors, Applications,		
Unit – IV: Drives and Controls	**No. of Lectures: 09 hours**	**Marks: 12**
Stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems. open and closed loop control; Embedded Systems, Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.		
Unit – V: Hydraulic & Pneumatic system	**No. of Lectures: 09 hours**	**Marks: 12**
Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. **Pneumatics:** production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Smart materials: Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;		
Text Books:		
1. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996. 2. HMT ltd. Mechatronics, Tata Mc graw Hill, New Delhi, 1988 3. Deb,S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994. 4. Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999. 5. A Textbook of Mechatronics, R. K. Raput, S. Chand Publishing 6. Mechatronics: Principles, Concepts and applications, Mahalik N.P, Tata McGraw Hill		
Reference Books:		
1. Introduction to Mechatronics, Kuttan, Oxford University 2. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall		

3. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)

ADVANCED MACHINING PROCESSES

COURSE OUTLINE

Course Title:	**Advanced Machining Processes**	**Short Title:**	**AMPs**	**Course Code:**	

Course Description:

The traditional machining methods even with added CNC features are unable to meet stringent demands of various industries such as electronics, automobiles, aerospace etc. As a result, a new class of machining processes has evolved over a period of time to meet such demands, named non-traditional, unconventional, modern or advanced machining processes. These advanced machining processes (AMPs) become still more important when one consider precision and ultra- precision machining. These advanced machining processes are based on the direct application of energy for material removal by mechanical erosion, thermal erosion or electro- chemical/ chemical dissolution.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Workshop Practice, Manufacturing Technology

Course Objectives:

In today technology development scenario, there is a requirement to develop a machine tool and the processes that can easily machine difficult- to- cut material or a workpiece to produce desired shape and accurate profile. To overcome these challenges number of new material removal processes has been developed. These new material removal methods are also called as non-conventional where conventional tools are not suitable for machining. This course will provide the students up-to-date with the latest technological developments and research trends in the area of unconventional/non-traditional/modern machining processes.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Understand various advanced machining processes with their advantages, disadvantages and their applications.
2. Able to understand different types of composite material characteristics, types of micro & nan machining processes
3. Select a proper NTM method for given component
4. Understand concepts of machining for selection of appropriate machining parameters, and cutting tools for ECM
5. To learn the concepts and principles of advanced chemical machining processes

COURSE CONTENT

Advanced Machining Processes		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Bulk Material Removal Processes: Introduction: - Abrasive jet machining setup-Gas propulsion system-abrasive feeder-machining chamber-AJM nozzle-Abrasives, Process capabilities, applications, Introduction and working: - Ultrasonic Machining system, Process capabilities, applications, Introduction and working:- Water Jet Machining (WJM) and Abrasive water jet machining (AWJM)		
Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**
Micro/Nano finishing processes: Introduction, Abrasive flow machining (AFM) process variables, applications Magnetic abrasive finishing (MAF), Magneto-reheological finishing (MRF), Magnetic float polishing (MFP), Elastic emission machining (EMM), Ion beam machining (IBM).		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Thermal Advanced Machining Processes: - Introduction, Plasma arc machining (PAM), Laser beam machining (LBM), Electron beam machining (EBM), Electro-discharge machining (EDM).		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Electro-Chemical Machining: - Introduction, Electro Chemical Machining (ECM) principle, working, advantages, disadvantages, applications, Chemical Machining (ChM), Introduction, principle, working, advantages, disadvantages, applications		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Chemical Advanced Machining Processes: - Bio chemical machining (BM), Introduction, principle, working, advantages, disadvantages and applications, Electro chemical grinding (ECG), Introduction, ECG machine tool, process characteristics, applications.		
Text Books:		
1.Advanced Machining Processes by V. K. Jain, Allied Publishers, New Delhi 2009 2. Manufacturing Technology Volume 2 by P. N. Rao Tata McGraw Hill Education Private Limited, New Delhi. 2009 3.Gary F. Benedict, Non-Traditional Manufacturing Processes, Taylor & Francis 1987 4.J. A. Mcgeough, Advanced Methods of Machining, Springer 1988		
Reference Books:		
1. P. K. Mishra, Non-Conventional Machining, Narosa India publication, 1997 2. Hassan EI-Hofy, Advanced Machining Processes: Non-traditional and hybrid Machining Processes, McGraw-Hill 2005 3. P. C. Pandey and H. S. Shan, Modern Machining Processes, Tata McGraw-Hill 1980 4. James A. Brown, Modern Manufacturing Processes, Industrial Press, 1991 5. V. K. Jain, Introduction to Micromachining, Alpha Science International Limited, 2010		

<table>
<tr><td colspan="6">Power Plant Engineering</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Course Title:</td><td>Power Plant Engineering</td><td>Short Title:</td><td>PPE</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course Description:</td></tr>
<tr><td colspan="6">To understand the various components, operations and applications of different types of power plants.</td></tr>
</table>

<table>
<tr><td rowspan="2">Lecture</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester Credits</td></tr>
<tr><td>3</td><td>14</td><td>42</td><td>3</td></tr>
<tr><td colspan="5">Pre-requisite Course(s):</td></tr>
<tr><td colspan="5">Fundamental knowledge of engineering thermodynamics, applied thermodynamics & turbo machinery.</td></tr>
<tr><td colspan="5">Course Objectives:</td></tr>
<tr><td colspan="5">To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels. Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Course Outcomes:</td></tr>
<tr><td colspan="5">After successfully completion of this course students will be able to:
1. Explain the layout, construction and working of the components inside a thermal power Plant.
2. Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
3. Explain the layout, construction and working of the components inside nuclear power plants.
4. Explain the layout, construction and working of the components inside Renewable energy power plants.
5. Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.</td></tr>
<tr><td colspan="5"></td></tr>
</table>

<table>
<tr><td colspan="4">COURSE CONTENT</td></tr>
<tr><td colspan="2">Power Plant Engineering</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination Scheme:</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td>End Semester Exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="2"></td><td>Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
<tr><td colspan="4"></td></tr>
</table>

<table>
<tr><td>Unit – I: COAL BASED THERMAL POWER PLANTS</td><td>No. of Lectures: 08 hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.</td></tr>
<tr><td colspan="3"></td></tr>
</table>

Unit – II: DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	No. of Lectures: 08 hours	Marks: 12
Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.		
Unit – III: NUCLEAR POWER PLANTS	**No. of Lectures: 08 hours**	**Marks: 12**
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.		
Unit – IV: POWER FROM RENEWABLE ENERGY	**No. of Lectures: 09 hours**	**Marks: 12**
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		
Unit – V: ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	**No. of Lectures: 09 hours**	**Marks: 12**
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.		
Text Books:		
1. Nag. P.K., “Power Plant Engineering”, Third Edition, TMH, New Delhi.		
Reference Books:		
1. El-Wakil. M.M., “Power Plant Technology”, TMH, New Delhi 2. Godfrey Boyle, “Renewable energy”, Open University, Oxford University Press in association with the Open University. 3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, “Power Plant Engineering”, Second Edition, Standard Handbook of McGraw – Hill.		

PRODUCT DESIGN

COURSE OUTLINE

Course Title:	**Product Design**	**Short Title:**	**PD**	**Course Code:**	

Course Description:

This course is designed with focus on theory, technologies and practical applications in the product design, development and management over whole product lifecycle.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Metrology and Quality Control

Course Objectives:

This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front-end processes. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Manage the development of an idea from concept through to production.
2. Employ research and analysis methodologies as it pertains to the product design process, meaning, and user experience.
3. Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
4. Demonstrate, apply, explain, and recognize basic engineering, mechanical, and technical principles for decision making
5. Use sustainable materials and manufacturing processes & Carry out cost and benefit analysis through various cost models.

COURSE CONTENT

Product Design		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research

Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance - establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods-TRIZ- axiomatic design.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity-based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing.		
Text Books:		
1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9		
Reference Books:		
1. Clive L. Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7 2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9 3. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education, ISBN 9788177588217 4. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141		

MACHINERY CONDITION MONITORING

COURSE OUTLINE

Course Title:	**Machinery Condition Monitoring**	**Short Title:**	**MCM**	**Course Code:**	

Course Description:

The subject of machinery condition monitoring has been recently receiving considerable attention in India owing to concerns related to equipment reliability and safety. This increasing interest is primarily due to the significant impact of economic changes and strong competition in the global market.

	Hours/week	No. of weeks	Total hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Pre-requisite Course(s):

Engineering mechanics, Strength of materials

Course Objectives:

The objectives of this course will provide students/engineers/managers with the state-of-the-art techniques in machinery condition monitoring along with the recent developments in the field of signal processing, thermography, ultrasonic apart from the traditional noise and vibration monitoring. There will be demonstration of real time machinery health monitoring by various condition monitoring aspects.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Understand the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
2. Analyse for machinery condition monitoring and explain how these compliments monitoring the condition.
3. Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
4. Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
5. Identify vibration measurement, lubrication oil analysis

COURSE CONTENT

Machinery Condition Monitoring		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction, Maintenance – objectives – types – concepts and economic benefits, Preventive maintenance – time based & condition based, Condition Monitoring & Performance monitoring, Vibration Monitoring – causes and effects of vibration, Review of Fundamentals of Vibrations.

Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**

Vibration Measuring Equipment -Sensors, Signal conditioners, recording elements, Sensors – Factors affecting the choice of sensors, Contact type sensors – Non contact type sensors, Signal conditioning – Display/Recording elements, Vibration meters and analyser, Overall Level Measurement, Vibration limits & Standards.		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Signal Analysis - Frequency Analysis, Measurement of overall vibrations levels, Vibration limits and standards, Case studies, Special Vibration Measuring Techniques, Shock Pulse Method, Kurtosis, Cepstrum Analysis, Critical speed analysis, Orbit, vibration control, Wear behavior monitoring and Contaminants Monitoring Technique, Filters, chip detectors, Ferrography, Oil Analysis – oil degradation analysis, Abrasive Particle in oil, counters, Particle classification and counter.		
Unit – IV:	**No. of Lectures: 09 hours**	**Marks: 12**
Performance trend monitoring – Primary and secondary parameters, Performance trend analysis, Performance trend monitoring systems, Case studies, Temperature Monitoring – Various techniques – thermometer, thermocouple, Thermography, infrared pyrometers.		
Unit – V:	**No. of Lectures: 09 hours**	**Marks: 12**
Corrosion Monitoring – different techniques, Selection of condition motoring techniques, Non-destructive techniques – important features, Types of defects detected by NDT – Visual, Dye Penetration, Acoustic Emission and its applications, Xray, Radiographic, Magnetic Flux test.		
Text Books:		
1. Amiya R. Mohanty, MCM, CRC Press.		
Reference Books:		
1. Isermann R., Fault Diagnosis Applications, Springer-Verlag, Berlin, 2011. 2. Rao, J S., Vibration Condition Monitoring, Narosa Publishing House, 2nd Edition, 2000. 3. Allan Davies, Handbook of Condition Monitoring, Chapman and Hall, 2000		

<table>
<tr><td colspan="6">Database Management Systems</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSEOUTLINE</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Course Title:</td><td>Database Management Systems</td><td>Short Title:</td><td>DMS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course Description:</td></tr>
<tr><td colspan="6">C language</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Course Objectives:

1. Students will understand different issues involved in the design and implementation of a database system.
2. Students will learn the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. Students will learn the use of data manipulation language to query, update, and manage a database
4. Students will understand essential DBMS concepts such as: database integrity, concurrency and Indexing.
5. Students will think about applications of course material (to improve thinking, problem solving, and decisions)

Course Outcomes:

After successfully completion of this course students will be able to:

1. Identify entities in database and relate those entities
2. Construct the database queries in formal relational query languages
3. Construct the database queries in user oriented relational query language (SQL)
4. Normalize the database
5. Understand the concept of transaction processing system

COURSE CONTENT

<table>
<tr><td colspan="2">Database Management Systems</td><td>Semester:</td><td>VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination Scheme:</td></tr>
<tr><td>Lectures:</td><td>3 hours/week</td><td>End Semester Exam (ESE):</td><td>60 marks</td></tr>
<tr><td colspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
<tr><td colspan="2"></td><td>Internal Sessional Exams (ISE):</td><td>40 marks</td></tr>
</table>

Unit – I: Introduction to DBMS	**No. of Lectures: 09 hours**	**Marks: 12**

Database-System Applications, Purpose of Database Systems, View of Data: Data Abstraction, Instances and Schemas, data independence, Data Models: Relational Model, Entity-Relationship Model, Object-Based data model, Semi structured Data Model, Database Languages, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators

Database Design and E-R Model: Overview of the Design Process, The Entity Relationship Model: Entity Sets, Relationship Sets, Attributes, Constraints , Entity-Relationship Diagram: Basic Structure, Mapping Cardinality, Roles, Weak Entity sets, Extended E-R Features:

Specialization, Generalization, Attribute Inheritance, Constraints on Generalizations, Aggregation		
Unit – II: Formal Relational Query Languages	**No. of Lectures: 09 hours**	**Marks: 12**
The Relational Algebra: Fundamental Operations: The select Operation, The Project Operation, The Union Operation, The Set-Difference Operation, The Cartesian-Product Operation, The Rename Operation, Formal definition of Relational Algebra, Additional Algebra Operations: The Set-Intersection Operation, The Natural-Join Operation, The Assignment Operation, Outer Join Operations, Extended Relational-Algebra Operations: Generalized Projection, Aggregation		
Unit – III: Structured Query Language	**No. of Lectures: 08 hours**	**Marks: 12**
Queries Introduction to relational Model: structure of relational Databases, Database Schema, Keys, Schema Diagrams, Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions Nested Subqueries, Modification of the Database **Intermediate SQL:** Joined Expressions: Join Conditions, Outer Joins, Views, Integrity Constraints Functions and Procedures, Triggers		
Unit – IV: Storage strategies and Relational Database Design	**No. of Lectures: 08 hours**	**Marks: 12**
Storage strategies - Indexing: Basic concepts, Ordered Indices, B+ tree Index Files **Relational Database Design:** Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies: Keys and Functional Dependencies, Boyce-Codd Normal Form, BCNF and Dependency Preservation, Third Normal Form, Decomposition Using Multivalued Dependencies: Multivalued Dependencies, Fourth Normal Form		
Unit – V: Transaction Management and Architectures	**No. of Lectures: 08 hours**	**Marks: 12**
Transaction Management: Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability **Concurrency Control:** Lock-Based Protocols: Locks, Granting of Locks, The Two-Phase Locking protocol, Timestamp–Based Protocols: Timestamps, The Timestamps-Ordering Protocol **Recovery System:** Failure Classification, Storage, Recovery and Atomicity: Log records, Database Modification, Concurrency Control and Recovery, Transaction Commit, Using the Log to Redo and Undo Transactions **Database-System Architectures**: Centralized and Client–Server Architectures, Server System Architectures, Parallel Systems, Parallel Database Architectures**,** Distributed Systems		
Text Books:		
1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 6th Edition, McGraw-Hill.		
Reference Books:		

1. R. Ramkrishnan , J. Gehrke, "Database Management Systems", 3rd Edition, McGraw-Hill.
2. C. J. Date, “Introduction to Database Management Systems”, 8th Edition, Pearson.
3. R. Elmasri and S. Navathe “Fundamentals of Database Systems”, 5th Edition,Pearson
4. V.K.Jain, “Database Management System”, Dreamtech Press (Wiley India).
5. AtulKahate, “Introduction to Database Management System”, 3rd Edition, Pearson.
6. G. K. Gupta, “Database Management Systems”, McGraw–Hill.
7. S. K. Singh, “Database Systems Concepts, Design and Applications”, Pearson.
8. Bipin Desai, “Introduction to database management systems”, Galgotia.

MICROPROCESSOR & MICROCONTROLLERS IN AUTOMATION					
COURSE OUTLINE					
Course Title:	**Microprocessor & Microcontrollers in automation**	**Short Title:**	**MPMCA**	**Course Code:**	
Course Description:					
The objective of this course is to study the architecture and assembly language programming of microprocessor and microcontroller. To know about interfacing techniques of various I/O devices with microcontroller.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):
Basics in electrical and electronics engineering, C programming
Course Objectives:
The objective of this course is to study the architecture and assembly language programming of microprocessor and microcontroller. To know about interfacing techniques of various I/O devices with microcontroller.
Course Outcomes:
The student will be able to: 1. Understand the architecture of 8085 and 8086 Microprocessors 2. Develop the assembly language programs using 8086 instruction set 3. Understand the architecture of 8051 Microcontroller 4. Develop the assembly language programs using 8051 instruction set 5. Design the interfacing of I/O devices with 8051 Microcontroller
COURSE CONTENT

Machinery Condition Monitoring		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 08 hours**	**Marks: 12**
Architecture of Microprocessors: General definitions of mini computers, microprocessors, micro controllers and digital signal processors, Overview of 8085 microprocessor, Overview of 8086 microprocessor, Signals and pins of 8086 microprocessor.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Assembly language of 8086: Description of Instructions, Assembly directives, Algorithms with assembly software programs		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Architecture of microcontroller: Overview of the architecture of 8051 Micro controller, Interfacing of external Memory, I/O devices and serial communication with typical microcontrollers.		

Unit – IV:	No. of Lectures: 09 hours	Marks: 12
Assembly language of 8051: Description of Instructions, Assembly directives, Algorithms with assembly software programs.		
Unit – V:	**No. of Lectures: 09 hours**	**Marks: 12**
Interfacing with keyboards, LEDs, 7 segment LEDs, LCDs, ADCs, DACs.		
Text Books:		
1. Kenneth Ayala, "The 8051 Micro controller" Cengage Learning 2. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085" 5/e, Penram International Publishing Pvt. Ltd. 3. Douglas Hall, "Microprocessor and Interfacing", TMH.		
Reference Books:		
1. Ajay Deshmukh, "Micro controller: Theory and application", TMH. 2. Predko, "Programming and customizing 8051 Micro controller", TMH. 3. "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson		

RESEARCH METHODOLOGY

COURSE OUTLINE

Course Title:	**Research Methodology**	**Short Title:**	**RM**	**Course Code:**	

Course Description:

Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in social sciences and business management context.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Basic Mathematics, English

Course Objectives:

The course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach.

Course Outcomes:

After successfully completion of this course students will be able to:
1. develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
2. apply basic knowledge on qualitative research techniques
3. apply knowledge on measurement & scaling techniques as well as the quantitative data analysis
4. perform data analysis-and hypothesis testing procedures
5. write and interpret the report and thesis in technical way.

COURSE CONTENT

Research Methodology		**Semester:**	**VII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Computer and its role in research, Use of statistical software SPSS, GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.		
Text Books:		
1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., “An introduction to Research Methodology”, RBSA Publishers. 2. Kothari, C.R., “Research Methodology: Methods and Techniques”, New Age International. 3. Sinha, S.C. and Dhiman, A.K., “Research Methodology”, Ess Ess Publications. 2 volumes. 4. Trochim, W.M.K., “Research Methods: the concise knowledge base”, Atomic Dog Publishing. 5. Wadehra, B.L., “Law relating to patents, trademarks, copyright designs and geographical indications” Universal Law Publishing.		
Reference Books:		
1. Anthony, M., Graziano, A.M. and Raulin, M.L., “Research Methods: A Process of Inquiry”, Allyn and Bacon. 2. Carlos, C.M., “Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options”, Zed Books, New York. 3. Coley, S.M. and Scheinberg, C. A., "Proposal Writing", Sage Publications. 4. Day, R.A., “How to Write and Publish a Scientific Paper”, Cambridge University Press. 5. Fink, A., “Conducting Research Literature Reviews: From the Internet to Paper”, Sage Publications 6. Leedy, P.D. and Ormrod, J.E., “Practical Research: Planning and Design”, Prentice Hall. 7. Satarkar, S.V., “Intellectual property rights and Copy right”, Ess Ess Publications.		
DESIGN OF MACHINE ELEMENT LAB		
COURSEOUTLINE		

<table>
<tr><td>Course Title:</td><td colspan="3">Design of Machine Element</td><td>Short Title:</td><td>DOME</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="8">Course Description:</td></tr>
<tr><td colspan="8">This course aims to equip the mechanical engineering students with the fundamentals of design activities and give them necessary skills to prepare complete, concise, and accurate calculation steps for machine elements. While the first part of the machine elements covering general stress analysis, failure conditions, shaft, spring, permanent and nonpermanent joints design, rolling contact and journal bearings, gears, clutches, flywheels, etc.</td></tr>
<tr><td rowspan="2">Laboratory</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td>Semester Credits</td></tr>
<tr><td>02</td><td>14</td><td>28</td><td>01</td></tr>
<tr><td colspan="8">Pre-requisite Course(s):</td></tr>
<tr><td colspan="8">The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td colspan="8">1. To study the basic design principles
2. To familiarize with use of design data books & various codes of practice
3. To make conversant with preparation of working drawings based on designs</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course Outcomes:</td></tr>
<tr><td colspan="8">After successfully completion of this course students will be able to:
1. Design shaft under various conditions
2. Design Coupling
3. Design Permanent Joints and Temporary Joints
4. Design Leaf spring
5. Convert design dimensions into working/manufacturing drawing
6. Use design data book/standard codes to standardize the designed dimensions</td></tr>
<tr><td colspan="8"></td></tr>
</table>

<table>
<tr><td colspan="6">DESIGN OF MACHINE ELEMENT LAB</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSEOUTLINE</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Course Title:</td><td>Design of Machine Element</td><td>Short Title:</td><td>DOME</td><td>Course Code:</td><td></td></tr>
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<tr><td colspan="6">This course aims to equip the mechanical engineering students with the fundamentals of design activities and give them necessary skills to prepare complete, concise, and accurate calculation steps for machine elements. While the first part of the machine elements covering general stress analysis, failure conditions, shaft, spring, permanent and nonpermanent joints design, rolling contact and journal bearings, gears, clutches, flywheels, etc.</td></tr>
</table>

Laboratory	Hours/week	No. of weeks	Total hours	Semester Credits
	02	14	28	01

Pre-requisite Course(s):

The sound knowledge of Mathematics (Calculus), Engineering Mechanics, SOM and TOM subjects

Course Objectives:

1. To study the basic design principles
2. To familiarize with use of design data books & various codes of practice
3. To make conversant with preparation of working drawings based on designs

Course Outcomes:

After successfully completion of this course students will be able to:
1. design shaft under various conditions
2. design Coupling
3. design Permanent Joints and Temporary Joints
4. design Leaf spring
5. convert design dimensions into working/manufacturing drawing and use of design data book/standard codes to standardize the designed dimensions

COURSE CONTENT

Design of Machine Element Lab		Semester:	VII
Teaching Scheme:		**Examination Scheme:**	
Practical:	**02 hours/week**	**End Semester Exam (ESE): oral**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 Marks**

Term work - Shall consist of

A. Design and detailed assembly drawing (computer aided drawing) of minimum two design problems, from the following.

1) Flexible flange coupling 2) Leaf spring 3) Spur Gear Box 4) Helical Gear Box 5) Worm Gear Box

B. Assignment: Design exercises in the form of design calculations with sketches and/ or drawings.

C. Course Project: Students in a group of two to four will be able to design and prepare working drawings (using any software) of any system having minimum 5 to 6 components by applying the knowledge gained during the course

Text Books:
1. Bhandari V.B., “Design of Machine elements”, Tata McGraw Hill Pub. Co. ltd. 2. Farzdak Haideri, “Machine Design”, Nirali Prakashan, Pune 3. R. B. Patil, “Mechanical System Design” Techmax publications, 4th edition (2018)
Reference Books:
1. Shigley J.E. and Mischke C.R., “Mechanical Engineering Design”, McGraw Hill Pub. Co. Ltd 2. Spott’s M.F. and Shoup T.E. “Design of Machine Elements”, Prentice Hall International. 3. “Design Data”, P.S.G. College of Technology, Coimbatore. 4. Juvinal R.C. “Fundamental of Machine Component Design”, John Wiely and sons. 5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
Guidelines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Computer Aided Design Lab					
COURSE OUTLINE					
Course Title:	**Computer Aided Design Lab**	**Short Title:**	CAD	**Course Code:**	
Course description:					
The course presents the elements of solid modelling, creation of parts of increasing complexity and the assembly of parts to form a final design, along with mechanism simulation. The operation and programming of CNC machines is covered.					
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	
Lecture	01	14	14	02	
Practical	02	14	28		
Prerequisite course(s):					
Fundamental knowledge about the Design and Automation of Manufacturing Process, Strength of Materials, Engineering Mechanics, etc					
Course objectives:					
1. To understand the concept of Computer Aided Design & Manufacturing 2. To understand the concept of Automation, F.M.S., G.T. & Robotics 3. To be familiar about CNC Programming					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Apply the concepts of Computer Aided Design. 2. Apply the concepts of Computer Aided Graphics. 3. Apply the concepts of Computer Aided Modelling & Automation. 4. Apply the concepts of Computer Aided Manufacturing & C.N.C. Programming 5. Apply the concepts of Introduction to FMS, GT and Robotics					
COURSE CONTENT					
Computer Aided Design Lab		**Semester:**	VII		
Teaching Scheme:		**Examination scheme**			
Lectures:	**1 hours/week**	**End Semester Exam (ESE): Practical**		**25 Marks**	
		Internal Continuous Assessment (ICA):		**25 Marks**	
Unit–I: Introduction To CAD/CAM and Networking		**No. of Lectures: 03 Hours**			
Define CAD/CAM, Product Life Cycle & CAD/CAM, and Application of Computers for Design Process, Selection of a CAD system, Benefits & Application of CAD. Computer communication, Principle of networking, Classification of network, Transmission media & interface, LAN system.					
Unit–II: Computer Aided Graphics		**No. of Lectures: 02 Hours**			
Introduction, Graphic Primitives, Point plotting, drawing of lines, Coordinate system used in graphic element, Transformation in graphics, Homogeneous transformation, Concatenate coordinate transformation, Translation, Rotation, Scaling, Mirror, Reflection					

Unit–III: Computer Aided Modeling & Automation	**No. of Lectures: 03 Hours**	
Requirement of Geometric Modeling, Geometric Model, Geometric Model Construction Method: Wire Frame Modeling, Surface Modeling, Solid Modeling Concept of Automation, Types of Automation, Advantages & limitations of Automation.		
Unit–IV: Computer Aided Manufacturing	**No. of Lectures: 03 Hours**	
Continuous control system, Discrete control system, Computer process control, Forms of CPC, Computer process Monitoring, Direct Digital Control, Manual Part Programming using G and M codes		
Unit–V: Introduction to FMS, GT and Robotics	**No. of Lectures: 03 Hours**	
FMS – Introduction, Components of FMS, Types of FMS, Application & Benefits, Typical FMS layout GT – Part families, Part classification & coding, Application of GT. Robotics – Robot Anatomy, Robot Control System, End effectors, Sensors, Industrial Robot, Application and its selection		
List of Practical's: A. Introduction to Modelling (Using any CAD software). 1. 2D drawing using sketcher- 2 Drawings 2. 3D modelling using 3D features (Modelling of any four components of any mechanical assembly) 3. Assembling and drafting (Above assembly) with proper mating conditions and interference checking. 4. Surface Modelling (Any 2 of the above components). B. Three assignments based on above syllabus. C. Study of Part programming for CNC lathe D. Study of Part programming for CNC milling machine E. Study of APT programming **ESE** **(Practical Examination)** The Practical Examination will comprise of performing the experiment and viva on the Practical's.		
Text Books:		
1. CAD/CAM & Automation by R.B. Patil, Tech- Max. Publication 2. Rao P.N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co. 3. B. S. Pabla, M. Adithan, "CNC Machine ", New Age International(P) Ltd. 4. Rao, Tiwari, Kundra, "Computer Aided Manufacturing", T.M.H.		
Reference Books:		

1. Ibrahim Zeid and R. Sivasubramanian, “CAD/CAM – Theory and Practice”, Tata McGraw Hill Publishing Co. 2009
2. Ibraim Zeid, “Mastering CAD/CAM” – Tata McGraw Hill Publishing Co. 2000.
3. Groover M. P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India
4. Yoram Koren - Robotics McGraw Hill Publishing Co.
5. James G. Keramas, Robot Technology Fundamentals, Delmar Publishers.
6. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
7. P. Radhkrishnan, S. Subramanyam, V. Raju, “CAD/CAM/CIM”, New Age Publication.
8. Mikell P. Grover, Emory W. Zimmers, “Computer Aided Design and Manufacturing”, P.H.I.
9. Zeid, “CAD/CAM”, T.M.H.

<table>
<tr><td colspan="8" align="center">Project (Stage – I)</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td colspan="3">Project (Stage – I)</td><td>Short Title:</td><td>PROJ-SI</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="8">Course description:</td></tr>
<tr><td colspan="8">Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.</td></tr>
<tr><td rowspan="2">Laboratory</td><td colspan="2">Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td colspan="2">12</td><td>14</td><td colspan="2">168</td><td colspan="2">6</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="5">Oral (OR)</td></tr>
<tr><td colspan="8">Prerequisite course(s):</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course objectives:</td></tr>
<tr><td colspan="8">1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course outcomes:</td></tr>
<tr><td colspan="8">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="8">1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Project (Stage – I)</td><td colspan="4">Semester:</td><td colspan="2">VII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="6">Examination Scheme:</td></tr>
<tr><td rowspan="2">Practical:</td><td rowspan="2">12 hours/week</td><td colspan="4">End Semester Exam (ESE): OR</td><td colspan="2">50 marks</td></tr>
<tr><td colspan="4">Internal Continuous Assessment (ICA):</td><td colspan="2">50 marks</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">At the final year the students shall carry out a project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester –VII the students shall complete the partial work, and by the end of Semester –VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project may be either fully theoretical/practical or involving both</td></tr>
</table>

theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of spiral bound at the end of Semester –VII. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract
Chapter 1. Introduction

Chapter 2. Project Planning and Management

Chapter 3. Literature Review

Chapter 4. Research Gap, Problem Statement and Objective

Chapter 5. Conclusion

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (Stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:
In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

COURSE OUTLINE

Course Title:	**Essence of Indian Traditional Knowledge**	**Short Title:**	**EITK**	**Course Code:**	

Course description:

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	-----	14	-----	1

Prerequisite course(s):

Course objectives:

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Course outcomes:

After successful completion of this course the student will be able to:

1. understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.
2. adopt traditional methods of Ayurveda and Yoga for happy and healthy life
3. practice classical music and dance
4. understand about ancient architecture

COURSE CONTENT

Essence of Indian Traditional Knowledge		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	-----	**End semester exam (ESE):**	----
		Duration of ESE:	----
		Internal Sessional Exams (ISE):	----

Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
   5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

Reference Books:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.
11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher
13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayatri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering (Mechanical Engineering) Faculty

of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

Syllabus Structure & Contents of Fourth Year of Engineering

Semester-VIII

w.e.f. 2021 – 2022

REFRIGERATION AND AIR CONDITIONING

COURSE OUTLINE

Course Title:	**Refrigeration and Air Conditioning**	**Short Title:**	**RAC**	**Course Code:**	

Course Description:

This course familiarizes under graduate students with the terminologies associated with Refrigeration and Air-conditioning. The course will help students to understand phenomenon of refrigeration with basic properties of refrigerants and build student's ability to solve refrigeration problems. The course also includes basic principles of psychrometry, applied psychometrics and study of different air conditioning system such air windows Air-conditioning and use of Psychrometric chart to study the behavior of moist air at different conditions.

	Hours/week	No. of weeks	Total hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Pre-requisite Course(s):

Applied Physics, Fundamentals of Thermodynamics

Course Objectives:

1. To familiarize with the terminology associated with refrigeration systems and air conditioning.
2. To understand basic refrigeration processes.
3. To learn about the basics of psychrometry and practice of applied psychometrics.
4. To acquire the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Understand the principles of refrigeration and remember the application of air refrigeration.
2. Learn the working of single stage, multistage and Multi-Evaporator using vapour compression refrigeration system with different type of refrigerants.
3. Study the working principles and its application of vapor absorption refrigeration system.
4. Apply the knowledge of psychrometry to various psychrometric processes in Air-conditioning system.
5. Learn different types of Air-Conditioning system used for Human comfort and Use P-h, T-S and Psychometric charts to solve refrigeration and Air conditioning design problems.

COURSE CONTENT

Refrigeration and Air Conditioning		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Refrigeration Systems	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction, Need of Refrigeration, Standard Rating of Refrigerating Machine, Coefficient of Performance of Refrigerator and Heat Pump, Classification of Refrigeration Systems, Air

Refrigeration - Reversed Carnot Cycle and Its Limitation, Bell-Coleman Cycle, Merits and Demerits of Air Refrigeration, Need of Aircraft Refrigeration, Working and Analysis of aircraft Refrigeration Systems.		
Unit – II: Vapour Compression Refrigeration System	**No. of Lectures: 10 hours**	**Marks: 12**
Working of Simple Vapour Compression System, System Components: Classification of Compressors, Condensers, Expansion Devices and Evaporators. Representation of Theoretical Vapour Compression Cycle (VCC) On T-S And P-H Diagram, Effect of Superheating and Subcooling, Use of Refrigeration Table and Chart, Actual Vapour Compression Cycle, Compound Vapour Compression System with Inter Cooling, Flash Chamber and Multi Evaporators Systems, Refrigerants and Their Mixtures: Designation, Properties and Characteristics, Ozone Depletion and Global Warming Issues.		
Unit – III: Vapour Absorption Refrigeration Systems	**No. of Lectures: 07 hours**	**Marks: 12**
Simple & Practical Vapour Absorption Refrigeration Systems, COP of Vapour Absorption Refrigeration Systems, Desirable Properties of Absorbent-Refrigerant Combinations, Electrolux Refrigerator, Lithium-Bromide Refrigeration System, Enthalpy Concentration (H-C) Charts, Analysis of Aqua -Ammonia Refrigeration System Using H-C Chart.		
Unit – IV: Psychrometry	**No. of Lectures: 08 hours**	**Marks: 12**
Psychrometric - Properties of Moist Air, Sling Psychrometers, Psychrometric Relations, Psychrometric Chart, Basic Psychrometric Processes, Bypass Factor, Sensible Heat Factor, Concept of Enthalpy Potential – Air Washers, Evaporative Condensers, Cooling and Dehumidifying Coils. Adiabatic Mixing of Air Stream.		
Unit – V: Air Conditioning System	**No. of Lectures: 09 hours**	**Marks: 12**
Comfort Chart, Classifications of Air-Conditioning Systems, Summer, Winter and Year-Round Air Conditioning, Window and Central Air Conditioning Systems, Applications of AC Systems, Room Sensible Heat Factor (RSHF), Grand Sensible Heat Factor GSHF, Effective Room Sensible Heat Factor (ERSHF), Cooling Load Estimation - Components of Cooling Loads.		
Text Books:		
1. Khurmi Gupta, “Refrigeration and Air- Conditioning”, S Chand, New Delhi. 2. Monohar Prasad, "Refrigeration and air conditioning”, New Age Publishers, New Delhi. 3. Arora and Domkundawar, “Refrigeration and air conditioning”, Dhanpatrai and Sons, New Delhi.		
Reference Books:		
1. Arora C. P., "Refrigeration and air conditioning”, TMH, New Delhi. 2. Ananthnarayanan, "Basics of Refrigeration”, TMH, and New Delhi. 3. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982. 4. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986. 5. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.		

ROBOTICS					
COURSE OUTLINE					
Course Title:	**Robotics**	**Short Title:**	**RBT**	**Course Code:**	
Course Description:					
This course is aimed to provide exposure on the Robot anatomy, sensors, kinematics, applications and problems associated with their design.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):
Fundamental knowledge of Mathematics, Automation, Mechatronics.
Course Objectives:
1) To understand the basic concepts associated with the robot functioning and applications of Robots. 2) To study about the robot motion analysis of robot. 3) To study about the drives and control system used in Robots. 4) To understand the concepts of end effectors, sensors and vision system used in robots 5) To learn about robot programming
Course Outcomes:
After successfully completion of this course students will be able to:
1) To know about fundamental knowledge about the robot 2) To know about robot motion analysis 3) To know about drives and control system used in robots. 4) To know about end effectors, sensors and vision system. 5) To know about robot programming methods and languages.

COURSE CONTENT			
Robotics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**
BASIC CONCEPT IN ROBOTICS		
Historical perspective of robot, definition of robot, need of robots, classification of robot, automation and robotics, robot anatomy, basic structure of robotics. resolution, accuracy and repeatability, Classification of configuration of robot, point to point and continuous system, control loop of robotics system, Points considered for Selection of Robot, Degree of Freedom of robot, comparison of the human and robot manipulator, Robot joints, Application of robot.		
Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**
ROBOT MOTION ANALYSIS		
Introduction, Robot arm kinematics, Transformations, rotation matrix, geometric interpretation of rotation matrix, inverse transformation, composite transformation, Kinematics chain, Forces encountered in Moving coordinate systems Lagrange's Analysis of Manipulator.		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
DRIVES AND CONTROL SYSTEM		

<table>
<tr><td colspan="3">Robot drive system, Hydraulic system for robot, Pneumatic actuators, Electric drives DC servo motor, AC servo motor, stepper motor, Robot activation and feedback component, positional and velocity sensors. power transmission system, Application of robot.</td></tr>
<tr><td>Unit – IV:</td><td>No. of Lectures: 08 hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">END EFFECTORS, SENSORS AND VISION SYSTEMS</td></tr>
<tr><td colspan="3">End Effectors Types of end effectors, mechanical grippers, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper selection and design, force analysis of gripper mechanism, Introduction to Sensors: Need of sensors in a robotic system, selection of sensors, classification of sensor, photo sensors, limit switches. Range sensors, force/ torque sensors, proximity sensors, touch sensors, tactile sensors. VISION SYSTEMS: concept of low level and high-level vision in a robotic system.</td></tr>
<tr><td>Unit – V:</td><td>No. of Lectures: 08 hours</td><td>Marks: 12</td></tr>
<tr><td colspan="3">ROBOT PROGRAMMING</td></tr>
<tr><td colspan="3">Methods of robot programming, On line Programming, Teach Pendant Programming, Walk through Programming, off line programming and lead through programming methods, a robot program as a path in space. Motion interpolation WAIT, SIGNAL, AND DELAY commands.
ROBOT LANGUAGES: The textural robot languages, generation of robot programming languages, robot language structure, constant, variables and other. data objects, motion commands, end effector and sensor commands</td></tr>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td colspan="3">1.Industrial Automation and Robotics by A. K. Gupta & S. K. Arora
2. Industrial Robotics by Ganesh S. Hedge
3. CAD/CAM & Automation by R. B. Patil</td></tr>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td colspan="3">1) Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2) Groover,” Industrial Robotics”, McGraw Hill Publication Co. Ltd
3) John J. Craig, “Introduction to Robotics Mechanics and Control”, Pearson Education Inc.,
4) M. P. Groover, “Industrial Robotics - Technology, Programming and Applications”
5) Niku, “Introduction to Robotics: Analysis System and Application”, Pearson Education</td></tr>
</table>

3D PRINTING

COURSE OUTLINE

Course Title:	3D Printing	Short Title:	3DP	Course Code:	

Course Description:

3D printing refers to the manufacturing process that additively forms or creates a physical object from a digital design. There are various 3D printing technologies and materials, and all are based on the same principle that, a digital model is reshaped to the solid three-dimensional object by adding layer after the layer.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	14	42	3

Pre-requisite Course(s):

Engg. Drawing, Manufacturing Technology, Material Engg.

Course Objectives:

The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

Course Outcomes:

After successfully completion of this course students will be able to:

1. Develop CAD models for 3D printing.
2. Import and Export CAD data and generate .stl file.
3. Select a specific material for the given application.
4. Select a 3D printing process for an application.
5. Produce a product using 3D Printing or Additive Manufacturing (AM)

COURSE CONTENT

3D Printing		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	No. of Lectures: 08 hours	Marks: 12

3D Printing (Additive Manufacturing)

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing

processes, Applications.

CAD for Additive Manufacturing: CAD Data formats, Data translation, Data loss, STL format.

Unit – II:	No. of Lectures: 08 hours	Marks: 12

Additive Manufacturing Techniques: i) Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. ii) Process, Process parameter, Process Selection for various applications. iii) Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Materials: i) Polymers, Metals, Non-Metals, Ceramics ii) Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. iii) Support Materials		
Unit – IV:	**No. of Lectures: 09 hours**	**Marks: 12**
Additive Manufacturing Equipment: i) Process Equipment- Design and process parameters ii) Governing Bonding Mechanism iii) Common faults and troubleshooting iv) Process Design		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
1. Post Processing: Requirement and Techniques 2. Product Quality: i) Inspection and testing ii) Defects and their causes		
Text Books:		
1. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi. 2. Kalani Kirk Hausman, Richard Horne, "3D Printing For Dummies", 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey		
Reference Books:		
1. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010. 2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011. 3. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017. 4. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013. 5. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001. 6. Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.		

RENEWABLE ENERGY SOURCES & TECHNOLOGY

COURSE OUTLINE

Course Title:	**Renewable Energy Sources & Technology**	**Short Title:**	**REST**	**Course Code:**	

Course Description:

This course looks at the operating principle of a range of non-conventional energy resources, materials used, characterization, and key performance characteristics. The technologies looked at will include, Solar energy, Wind, Batteries, Fuel cells, and Geothermal conversion.

Lecture	Hours/week	No. of weeks	Total hours	Semester Credits
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Physics, Basics of Electrical Engg., Material Engg.

Course Objectives:

The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

Course Outcomes:

After successfully completion of this course students will be able to:
1. describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
2. appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
3. understand the concept of Biomass energy resources and their classification, types of biogas plants- applications
4. acquire the knowledge of wave power & tidal power
5. acquire the knowledge of fuel cells & hydrogen energy

COURSE CONTENT

Renewable Energy Sources & Technology		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	No. of Lectures: 09 hours	Marks: 12

Solar Energy:
Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers,

storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaics - solar cells & its applications		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Wind Energy: Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Energy from Biomass: Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Energy from the ocean: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Fuel Cells: Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells. Hydrogen Energy: Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.		
Text Books:		
1. G.D. Rai, “Non-conventional energy sources”, Khanna Publishers, Delhi. 2. B. L. Singhal, “Alternative Energy Sources”, Tech Max Publication, Pune.		
Reference Books:		
1. S.Hasan Saeed and D.K.Sharma, “Non-Conventional Energy Resources”, Katson Books. 2. Duffic and Beckman, “Solar Engineering of Thermal Processes”, John Wiley, New Delhi. 3. H.P. Garg & Jai Prakash, “3Solar Energy: Fundamentals and Applications”, Tata McGraw Hill, Delhi.		

<table>
<tr><td colspan="6">Design of Transmission Systems</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td>Design of Transmission Systems</td><td>Short Title:</td><td>DTS</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="6">Course description:</td></tr>
<tr><td colspan="6">The course aims of imparting the knowledge of Transmission Systems. The background required includes knowledge of Physics, Engineering Maths, Kinematics and Theory of Machines. The objective of the course is to understand the Transmission Systems concept, gear design and its application.</td></tr>
</table>

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

<table>
<tr><td>Prerequisite course(s):</td></tr>
<tr><td>Fundamental Knowledge of Physics, Engineering Maths, Kinematics and Theory of Machines</td></tr>
<tr><td>Course objectives:</td></tr>
<tr><td>1. To learn about the design procedures for mechanical power transmission components
2. To understand the standard procedure available for Design of Transmission of Mechanical elements
3. To learn to use standard data and catalogues.</td></tr>
<tr><td></td></tr>
<tr><td>Course outcomes:</td></tr>
<tr><td>After successful completion of this course the student will be able to:</td></tr>
<tr><td>1. Apply the concepts of design to belts, chains and rope drives.
2. Apply the concepts of design to spur, helical gears.
3. Apply the concepts of design to worm and bevel gears.
4. Apply the concepts of design to gear boxes.
5. Apply the concepts of design to cams, brakes and clutches.</td></tr>
<tr><td></td></tr>
<tr><td>COURSE CONTENT</td></tr>
</table>

Design of Transmission Systems		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I: Flexible Transmission Elements	**No. of Lectures: 08 Hours**	**Marks: 12**
Design of Flat Belts & Pulleys, Selection of V-Belts and Pulleys, Selection of Hoisting Wire Ropes and Pulleys, Design of Chains and Sprockets		
Unit–II: Gear Transmission	**No. of Lectures: 08 Hours**	**Marks: 12**
Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.		
Unit–III: Straight Bevel Gear	**No. of Lectures: 08 Hours**	**Marks: 12**

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Unit–IV: Gear box	**No. of Lectures: 09 Hours**	**Marks: 12**

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Unit–V: Design of Cam, Clutches & Types of Brakes	**No. of Lectures: 09 Hours**	**Marks: 12**

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001
4. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.

Reference Books:

1. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
3. C.S.Sharma, Kamlesh Purohit, “Design of Machine Elements”, Prentice Hall of India, Pvt. Ltd., 2003.
4. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 2nd Edition, Tata McGraw-Hill Book Co., 2006.
5. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, 2005
6. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill BookCo.(Schaum‟s Outline), 2010
7. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
8. Ansel Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co, 2003.
9. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.

TOTAL QUALITY MANAGEMENT

COURSE OUTLINE

Course Title:	**Total Quality Management**	**Short Title:**	**TQM**	**Course Code:**	

Course Description:

This course exposes participants to contemporary knowledge and techniques of TQM. This would in turn enable the participant to articulate and implement quality improvement processes in the workplace, in line with the philosophy of Total Quality Management.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Quality Control.

Course Objectives:

To give the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.

Course Outcomes:

After successfully completion of this course students will be able to:
1. Implement the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization.
2. Understand the philosophies--including similarities and differences--of the gurus of TQM in order to better evaluate TQM implementation proposals offered by quality management organiza•tions and consultants.
3. Utilize Statistical Process Control (SPC) techniques as a means to diagnose, reduce and eliminate causes of variation.
4. Apply various quality improvement techniques.
5. Successfully implement process improvement teams trained to use the various quality tools for identifying appropriate process improvements & assess exactly where an organization stands on quality management with respect to the ISO 9000 quality management standard.

COURSE CONTENT

Total Quality Management		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Introduction to Quality Management:

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Principles & Philosophies of Quality Management: Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Statistical Process Control & Process Capability: Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP) – relevance to TQM, Terotechnology. Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Tools & Techniques for Quality Management: Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven old (statistical) tools. Seven new management tools. Bench marking and POKA YOKE.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Quality Systems organising & Implementation: Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality.		
Text Books:		
1. Janakiraman. B and Gopal. R. K., “Total Quality Management - Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006. 2. Suganthi.L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006. 3. Ramasamy Subburaj, “Total Quality Management”, Mc Graw Hill, New Delhi.		
Reference Books:		
1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education, (First Indian Reprints 2004). 2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.		

3. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 8th Edition, First Indian Edition, Cengage Learning, 2012.
4. ISO 9001-2015 standards

AUTOMOBILE ENGINEERING					
COURSEOUTLINE					
Course Title:	**Automobile Engineering**	**Short Title:**	**AE**	**Course Code:**	
Course Description:					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	03	14	42	03

Pre-requisite Course(s):

I. C. Engines, Theory of Machines, Basics of Electrical and Electronics

Course Objectives:

1. To develop competencies in performance analysis of vehicles
2. To provide insight into the electrical systems of an automobile
3. To familiarize with the latest technological developments in automotive technology
4. To make the student conversant with vehicle maintenance.
5. To understand the emerging trends of electric vehicles, hybrid electric vehicles and solar vehicles.

Course Outcomes:

After successfully completion of this course students will be able to:
1. To compare and select the proper automotive system for the vehicle.
2. To analyse the performance of the vehicle.
3. To diagnose the faults of automobile vehicles.
4. To apply the knowledge of EVs, HEVs and solar vehicles
5. Demonstrate the working of different types of final drives, steering gears and braking systems

Illustrate the constructional features of wheels, tyres and suspension systems

COURSE CONTENT			
Automobile Engineering		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Introduction to Automobile	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction to Automobile, History of Automobile, Types of Automobile, Automobile Industry, Special Purpose Vehicle.

Chassis: Classification of Chassis, Integral and Chassis less Construction, **Frame**, Functions of the frame, Types of the Frame, Defects in Frame, Sub Frame,

Body Automobile Wheels, Tyres: Introduction, Wheel Assembly, Wheel and Tyre Sizes, Types of wheels, Wheels balance, Rims, Tyres, Types of tyres, Tyres Construction and Constituents, Tyres thread Patterns, Load Ratings, Tyres Selections and Tyre Properties, Tyres Pressure and wear, Causes of Tyre Wear, Tyre size, Tyres maintenance, Factors increase life of tyre

Brake: Braking Requirements, Function of the brakes, Classification of the brakes b Hydraulic Brakes, Power Brakes, Air Brakes, Brake Efficiency & Stopping Distance, Factor Controlling the Stop of an Automobile, Brake Lining, Brake Testing & Testers, Brake Service		
Unit – II: Automobile Suspension	**No. of Lectures: 08 hours**	**Marks: 12**
Automobile Suspension: Function of Suspension system, Requirements of a Suspension System, Torque Rod, Stabilizer Bar, Air Suspension, Hydraulic Suspension, Types of Suspension Spring, Plastic springs for motor cars, Shackle, Shock Absorber, Front Axle Suspension System, Rear Suspension System, Spring and Suspension trouble shooting chart **Automobile Steering:** Introduction, Principle of Correct Steering, Requirements of steering system, Steering system functions , General arrangement of steering system, Steering gears and linkages , Power steering, Reversible and irreversible steering, Factor Affecting understeering and over-steering , Steering Gear, Steering gear ratio, Turning radius, Wheel alignment, Caster and Camber angle, Toe-in Toe-out, Steering Trouble and Causes, Factor Affecting the Steering Operation		
Unit – III: Automobile Transmission	**No. of Lectures: 09 hours**	**Marks: 12**
Clutch: Introduction., Clutch and its functions, Principles of Operations, Requirement of Clutch, Main Parts of clutch, Types of friction materials, Properties of good clutch lining, Types of clutches, Clutch Maintenance, Clutch troubles and their causes Factors Affecting the Power Transmitted by the Clutch, Propeller Shaft, Universal Joint, Rear Axle. **Gear Box:** Necessity of gear box. Sliding mesh, Constant mesh, and Synchromesh Gear selector mechanisms. Overdrives and hydrodynamic torque converter, Trouble shooting and remedies. **Propeller Shaft and Axle**: Propeller shafts and universal joints: Types and construction, Different types of universal joints and constant velocity joints Types of live axles; semi, three quarter and full floating axles Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine.		
Unit – IV: Automobile Electrical system and Air Conditioning	**No. of Lectures: 09 hours**	**Marks: 12**
Introduction to Starting System, Lead-Acid Battery, Recharging of Battery, Charging procedure, Battery voltage, Battery Capacity, Battery Rating, Battery Life, Factors affecting Battery life, Battery testing, Battery troubles b Introduction to Ignition System-Types, Introduction Charging System, Spark Plug Introduction To Wiring System, Standard Color coding, Tracking faults in wiring, Functioning of the Electrical system in an Automobile, Improvement in Electrical system in an Automobile. Air Conditioning System Refrigerant, Conventional Heating and Ventilation, Air Distribution Parts, Automatic Climate Control, Automatic Temperature Control System, Air Conditioning Troubleshooting, Heating System Troubleshooting		
Unit – V: Electric & Hybrid Electric Vehicles	**No. of Lectures: 08 hours**	**Marks: 12**
Introduction: Concept and environmental importance of EVs, HEVs and solar vehicles. Electric vehicles: Layout, construction and working. Hybrid electric vehicles: Types, layout, hybridization factor, plug in hybrid electric vehicles, fuel efficiency analysis. Challenges and future scope of EVs and HEVs.		

Text Books:
1. K. Newton, W. Seeds, T.K. Garrett, “Motor Vehicle”, 13th Edition, Elsevier publications. 2. Hans Hermann Braess, Ulrich Seiffen, “Handbook of Automotive Engineering”, SAE Publications. 3. William H. Crouse., “Automotive Mechanics”, Tata McGraw Hill Publishing House. 4. Joseph Heitner, “Automotive Mechanics”, C.B.S Publishers and Distributors. 5. SAE Manuals and Standards. 6. N. K. Giri, “Automobile Mechanics”. 7. P. S. Kohali, “Automobile Electrical Equipment”, Tata McGraw Hill Publishing House. 8. Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.
Reference Books:
1. Dr. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers distributors. 2. Crouse/Anglin “Automobile Mechanics”, Tata Mcgraw-Hill. 3. R. B. Gupta, Automobile Engineering, Satya Prakashan 4. Chris Mi, M. Abul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Willey. 5. Electric and Hybrid Vehicles, Tom Denton, Routledge. 6. Hybrid Electric Vehicle Technology, Automotive Research and Design, American Technical. 7. Husain, Iqbal, Electric and hybrid vehicles, 2nd edition, CRC Press. 8. Ron Hodkinson and John Fenton, Butterworth-Heinemann. Lightweight Electric/ Hybrid Vehicle Design. 9. Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Standards media.

COMPUTATIONAL FLUID DYNAMICS					
COURSE OUTLINE					
Course Title:	**Computational Fluid Dynamics**	**Short Title:**	**CFD**	**Course Code:**	

Course Description:

This course familiarizes under graduate students with the terminologies associated with computational fluid dynamics. The course will help students to understand phenomenon of computational fluid dynamics and build student's ability to solve computational fluid dynamics problems. The course also includes governing equation and Finite volume methods with discretization. Students will also familiarize with computational fluid dynamics tools to solve industrial problems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Thermodynamics, Applied Thermodynamics, Fluid Mechanics

Course Objectives:

1. To develop an understanding for the major theories, approaches and methodologies used in CFD.
2. To understand techniques used in computational fluid dynamics
3. To do discretize the governing equations by Finite Difference Method and Finite Volume Method.
4. To build up the skills in the actual implementation of CFD methods.
5. Students should be able to model fluid / heat transfer problems and apply fundamental conservation principles.

Course Outcomes:

After successfully completion of this course students will be able to:
1. comprehend the methodology of computational fluid dynamics (CFD).
2. understand and be able to numerically solve the governing equations for fluid flow.
3. understand and apply finite difference, finite volume and finite element methods to fluid flow problems.
4. understand how grids are generated.
5. ability to use a CFD tool effectively for practical problems and research

COURSE CONTENT			
Computational Fluid Dynamics		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I: Introduction to CFD	**No. of Lectures: 09 hours**	**Marks: 12**

Introduction to Computational Fluid Dynamics (CFD) – a research and design tool, CFD as third dimension of engineering supplementing theory and experiment, steps in CFD solution procedure, strengths and weakness of CFD, Types of fluids, basic concepts in laminar and turbulent flows, Laws governing fluid motion, continuity, Navier – stokes & energy equations. Exact solutions of N-S equations, Physical interpretation of governing equations and boundary conditions.

Unit – II: Grid Generation	**No. of Lectures: 08 hours**	**Marks: 12**

Transformation of coordinates. General principles of grid generation – structured grids in two and three dimensions, algebraic grid generation, differential equations-based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.

Unit – III: Finite Difference Discretization	**No. of Lectures: 09 hours**	**Marks: 12**

Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modeling-conservative property, upwind scheme, transporting property, higher order up winding. Finite difference applications in heat transfer – conduction, convection.

Unit – IV: Finite Volume Method	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretized equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases.

Unit – V: CFD as Practical Approach	**No. of Lectures: 08 hours**	**Marks: 12**

Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition types such as no slip, free slip, rotating wall, symmetry and periodic, wall roughness, initializing and solution control for the solver, Residuals, analyzing the plots of various parameters (Scalar and Vector contours such as streamlines, velocity vector plots and animation). Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ .

Text Books:

1. John D Anderson, “Computational Fluid Dynamics: The Basics with Applications”, Mc Graw Hill.
2. Versteeg, H. K. & W. Malalasekera, " An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Pearson Education, Ltd.
3. Atul Sharma, “Introduction to Computational Fluid Dynamics: Development, Application and Analysis”, Wiley.

Reference Books:

1. A. W. Date, “Introduction to Computational Fluid Dynamics”, Cambridge University Press, India.

2. J. Tu, G.-H. Yeoh and C. Liu. "Computational Fluid Dynamics: A practical approach", Elsevier.
3. Ferziger J. H., Springer P.M, "Computational Methods for fluid Dynamics", Verlag Berlin.
4. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press.
5. Sunderarajan M.K., "Computational Fluid Flow and Heat Transfer", 2nd Ed, Narosa Publishing.
6. Suhas V. Patankar, "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation.

GAS DYNAMICS AND JET PROPULSION

COURSE OUTLINE

Course Title:	**Gas Dynamics & Jet Propulsion**	**Short Title:**	**GDJP**	**Course Code:**	

Course Description:

The course aims at imparting knowledge of modes of Gas Dynamics and Jet Propulsion & its application. It includes compressible flow, its concept and flow through ducts. It also contains concepts of the normal , oblique shocks , jet propulsion and rocket propulsion.

	Hours/week	No. of weeks	Total hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Pre-requisite Course(s):

Thermodynamics, Applied Thermodynamics, Fluid Mechanics

Course Objectives:

1. To understand the features of compressible isentropic flows and irreversibility's like shocks.
2. To provide a basic knowledge of jet and rocket propulsion technologies.

Course Outcomes:

After successfully completion of this course students will be able to:

1. apply the concept of compressible flows and momentum energy equation.
2. apply the concept of isentropic flow variable area ducts.
3. to understand the concept of Non-isentropic in constant area ducts.
4. use the concept of gas dynamics in Jet Propulsion.
5. apply the concept of gas dynamics in Space Propulsion.

COURSE CONTENT

Gas Dynamics & Jet Propulsion		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**

Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow, variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.		
Text Books:		
1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2003. 2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, NewDelhi, 1996. 3. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008 4. H.S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing. 5. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley. 6. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975. 7. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1988		
Reference Books:		
1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – WesleyPublishing company, 1992. 2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 1975. 3. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York. 4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York, 1986. 5. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible Fluid Flow", John wiley, NewYork, 1953. 6. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 1999. 7. Somasundaram. PR.S.L.,"Gas Dynamics and Jet Propulsions”, New Age International Publishers, 1996. 8. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, 2008. 9. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980.J		

ENTREPRENEURSHIP, INNOVATIONS & STARTUPS

COURSE OUTLINE

Course Title:	**Entrepreneurship, Innovations & Startups**	**Short Title:**	**EIS**	**Course Code:**	

Course Description:

This course is a comprehensive “deep dive” into the crucial law-sensitive issues faced in the launching, financing, growing, and selling or winding down a new venture.

	Hours/week	No. of weeks	Total hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Pre-requisite Course(s):

Communication Skills

Course Objectives:

1. Understanding the concept and process of entrepreneurship - its contribution in and role in the growth and development of individual and the nation
2. Acquiring entrepreneurial quality, competency and motivation
3. Learning the process and skills of creation and management of entrepreneurial venture

Course Outcomes:

After successfully completion of this course students will be able to:
1. Understand the meaning and define a startup
2. Understand the meaning and triggers of idea generation
3. Understand the values, attitudes and motivation required by an Entrepreneur
4. Understand and apply the concept of Business Plan
5. Understand the methods of raising finance in primary market & the importance of secondary market for mobilization or resources

COURSE CONTENT

Entrepreneurship, Innovations & Startup		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Business Models & Intellectual Property:

The Creative Process: Ideation, management of innovation, design thinking based on a particular technology.

Opportunity Identification and Research– opportunity seeking and identification, feasibility analysis, business model development, and understanding the needs of the customer and the market.

Strategy, Planning & Team Building – forming a venture or project team, introduction to creating business plans, legal and financial issues of starting and maintaining a new venture, strategic planning for a new product, issues around the commercialization of intellectual property and new technology transfer models.		
Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**
Design Thinking for Innovation: Structuring and Packaging a Commercial idea – The value propositions, sustainable positioning, competitive advantage, presenting the idea in multiple formats, formulating new product development timelines and analysing strategic options. Integrating Continuous Feedback and Communicating Concepts to Different Audiences – Obtaining and integrating key feedback from multiple mentors, constantly adjusting the relevant information into a variety of communications options and to ability to identify relevant gaps.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Entrepreneurship: Introduction to Entrepreneurship: Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, agencies in entrepreneurship management and future of entrepreneurship. The Entrepreneur: Meaning of entrepreneur, the skills required to be an entrepreneur, the entrepreneurial decision process, and role models, mentors and support system		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Technology & Innovation Management: Business Opportunity Identification: Business ideas, methods of generating ideas, and opportunity recognition. Preparing a Business Plan: Meaning and significance of a business plan, components of a business plan, and feasibility study Launching the New Venture: Choosing the legal form of new venture, protection of intellectual property, and marketing the new venture.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Venture Capital & Growth Finance: Financing the New Venture: Importance of new venture financing, types of ownership securities, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks Managing Growth in New Venture: Characteristics of high growth new ventures, strategies for growth, and building the new venture capital Harvesting Rewards: Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.		
Text Books:		
1. Drucker, P. F. Innovation and Entrepreneurship: Principles and Practice 2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses 3. Muthu Singaram, "Entrepreneurship: A hands on guide to starting your business" 4. Prathistha Jain, Muthu Singaram, "Greenfields: Building a Stronger Ecosystem for Start-Ups and Entrepreneurs: Suggested Standard Operating Procedures for Incubators".		

Reference Books:
1. Osterwalder, A. and Pigneur, Y., “Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers”. 2. Thiel, P., “Zero to One: Notes on Startups, or How to Build the Future” 3. Christenson, Clayton, “The Innovator's Dilemma”,

INDUSTRIAL AND SYSTEM ENGINEERING
COURSE OUTLINE

Course Title:	**Industrial & System Engineering**	**Short Title:**	**ISE**	**Course Code:**	

Course Description:

This course gives idea about how to prepare job plan, work study for productivity improvement and different aspect of production planning and control. Systems engineering utilizes an inter-disciplinary problem-solving approach across the entire technical effort. This course will provide an overview of both theory and practice of the systems engineering discipline along with systems engineering design approach.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester Credits**
	3	**14**	**42**	**3**

Pre-requisite Course(s):

Communication Skills

Course Objectives:

1. It focuses on systems of people, money, knowledge, information, equipment, energy, and materials and may address mathematical, physical and social science concerns.
2. To equip students with capability to develop system solutions that optimally fulfil customer objectives with available resources.

Course Outcomes:

After successfully completion of this course students will be able to:
1. solve forecasting problem by applying different techniques & understand planning, scheduling and sequencing problems for shop floor.
2. apply work study techniques and understands its importance for better productivity.
3. demonstrate wage and incentive plans & acquire knowledge of industrial legislation.
4. create know-how on solving open-ended problems, utilizing creativity, problem formulation & generation of need statements.
5. apply various realistic aspects such as safety, reliability, manufacturability, operations, aesthetics, ethics and sustainability.

COURSE CONTENT

Entrepreneurship, Innovations & Startsup		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 09 hours**	**Marks: 12**

Types of Production systems and their Characteristics, functions and objectives of Production Planning and Control, Sales forecasting: Techniques and Applications, Steps of

Production Planning and Control: Process planning, Leading, Scheduling, Dispatching and Expediting with illustrative examples, Introduction to line of balance, assembly line balancing and progress control.		
Unit – II:	**No. of Lectures: 09 hours**	**Marks: 12**
Work System Design: Taylor's scientific management, Gilbreths's contributions; productivity – concepts and measurements; method study, micro-motion study, principles of motion economy; work measurement – time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes and wage administration.		
Unit – III:	**No. of Lectures: 08 hours**	**Marks: 12**
Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans. Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952.		
Unit – IV:	**No. of Lectures: 08 hours**	**Marks: 12**
Systems engineering – what is, origin, and examples, Systems engineering as a profession, Power of systems engineering and examples, Systems engineering viewpoint, perspectives, domains, Systems engineering fields, approaches, activities, and products. Complex system structure-building blocks, hierarchy, interfaces; Complex system structure-environment, interactions, complexity; System development process – life cycle, evolutionary characteristics; Systems engineering method; Systems testing throughout development.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Managing systems development, risks, work break down structure (WBS), systems engineering management plan (SEMP); Systems risk management, organizing for systems engineering, Need analysis – originating, operations, functional and feasibility; Need validation, systems ops requirement; System requirements development, performance requirements. Implementing concept exploration, validating requirements; Concept definition – selection and validation, functional analysis and allocation; Systems architecture, system modelling languages, Model-Based Systems Engg (MBSE).		
Text Books:		
1. R. Panneerselvam, "Production and Operations Management", PHI Private Ltd., 2. Martand Telsang, "Industrial Engineering and Production Management", S Chand & company. 3. Banga and Sharma, "Industrial Engineering and Production Management" Khanna Publishers. 4. Dr. B. Kumar, "Industrial Engineering and Management", Khanna Publishers 5. "Work study", International Labour Organisation, ILO		
Reference Books:		

1. Harold Amrine, John Ritchey, Moodie, Kmec "Manufacturing Organisation & Management", 6th Ed., Pearson
2. Production System, Planning, Analysis and Control – By J.L. Riggs 3rd ed. Wiley

INTERNET OF THINGS

COURSE OUTLINE

Course Title:	**Internet of Things**	**Short Title:**	**IOT**	**Course Code:**	

Course Description:

3D printing refers to the manufacturing process that additively forms or creates a physical object from a digital design. There are various 3D printing technologies and materials, and all are based on the same principle that, a digital model is reshaped to the solid three-dimensional object by adding layer after the layer.

	Hours/week	**No. of weeks**	**Total hours**	**Semester Credits**
Lecture	**3**	**14**	**42**	**3**

Pre-requisite Course(s):

Engg. Drawing, Manufacturing Technology, Material Engg.

Course Objectives:

The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry 4.0 environment.

Course Outcomes:

After successfully completion of this course students will be able to:
1. understand the design principles for connected devices
2. understand the design principles of Internet connectivity
3. analyze the concepts of knowledge acquiring, managing and storing
4. understand the wide variety of sensors
5. design the software for IoT applications

COURSE CONTENT

Internet of Things		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit – I:	**No. of Lectures: 08 hours**	**Marks: 12**

Internet of Things: An Overview: Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT.

Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability.

Unit – II:	**No. of Lectures: 08 hours**	**Marks: 12**

Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and Web Sockets **Internet Connectivity Principles**: Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others.		
Unit – III:	**No. of Lectures: 09 hours**	**Marks: 12**
Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes. **Data Collection, Storage and Computing Using Cloud Platform:** Cloud Computing Paradigm for Data Collection, Storage and Computing, everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms.		
Unit – IV:	**No. of Lectures: 09 hours**	**Marks: 12**
Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology. **Prototyping the Embedded Devices for IoT and M2M:** Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.		
Unit – V:	**No. of Lectures: 08 hours**	**Marks: 12**
Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs. **IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT.		
Text Books:		
1. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill.		
Reference Books:		
1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi.		

ARTIFICIAL INTELLIGENCE COURSE					
Course Title:	**Artificial Intelligence**	**Short Title:**	**AI**	**Course Code:**	

Course description:

This course is to introduce the students to the fundamentals of Artificial Intelligence, Expert Systems and Neural Networks and enable them to apply these concepts for solving real world problems.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**14**	**42**	**3**

Prerequisite course(s):

C language

Course objectives:

1. To understand the various characteristics of Intelligent agents
2. To learn the different search strategies in AI
3. To learn to represent knowledge in solving AI problems
4. To understand the different ways of designing software agents
5. To know about the various applications of AI.

Course outcomes:

After successful completion of this course the student will be able to:

1. Use appropriate search algorithms for any AI problem
2. Describe a problem using first order and predicate logic
3. Apply the apt agent strategy to solve a given problem
4. Design software agents to solve a problem
5. Design applications for NLP that use Artificial Intelligence.

COURSE

Artificial Intelligence		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Artificial Intelligence:

Definitions of AI, History, Turing test, AI Problem and Techniques: Problem as State Space Search, Problem characteristics, Production System: Water Jug problem, Heuristic Search Techniques: BFS, DFS, A*, AO*, Mean Ends Analysis

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Knowledge Engineering:

Knowledge Representation Issues, Knowledge Representation using Predicate Logic, Knowledge Representation using Rules, Weak and Strong Filler Structures for Knowledge: Semantic net, Frames, Script, Conceptual dependency.

Unit–III:	**No. of Lectures:08 Hours**	**Marks:12**

Game Playing and Planning:

Game Tree, Min-max Search with Additional Refinements, Overview of Planning and types Goal Stack Planning : Block World, STRIPS, Nonlinear, Hierarchical and Other, Planning

Unit–IV:	No. of Lectures:09 Hours	Marks:12
Understanding, NLP and Expert System: Understanding as a constraint Satisfaction: Waltz's algorithm, Constraint determination, Trihedral figures labeling, Natural Language Processing Steps, Learning Techniques, Introduction to Expert system, Architecture of Expert System, Expert System Shell Knowledge Acquisition in Expert System		

Unit–V:	No. of Lectures:08 Hours	Marks:12
Neural Network: Characteristics of Neural Networks: Features of Biological Neural Networks, Biological Neural Networks, Performance Comparison of Computer and Biological Neural Networks Historical Development of Neural Network, Artificial Neural Networks: Terminology Models of Neuron: McCulloch-Pitts Model, Perception, Adeline Topology, Basic Learning Laws Learning Methods: Supervised and unsupervised		

Text Books:

1. Elaine Rich, Kevin Knight and Shivshankar Nair" Artificial Intelligence".3rd Edition TMH.
2. B. Yegnanarayana "Artificial Neural Networks "PHI2005

Reference Books:

1. S. Rajasekaran and G.A. Vijayalakshmi, "Neural Networks, Fuzzy Logic, and Genetic Algorithms" PHI
2. Timothy J Ross, "Fuzzy Logic with Engineering Application", TMH
3. Dan W. Patterson, "Introduction to artificial intelligence and expert system", PHI.

REFRIGERATION & AIR CONDITIONING LAB

COURSE OUTLINE

Course Title:	**Refrigeration & Air Conditioning Lab**	**Short Title:**	**RACL**	**Course Code:**

Course Description:

In this laboratory, this course familiarizes under graduate students with the terminologies associated with refrigeration & air conditioning, basic principles of psychrometry and applied psychometrics, refrigerants; vapor compression refrigeration and multi-stage vapor compression systems, components of vapor compression systems and other types of cooling systems. The learner can use this knowledge and apply in various industries as required.

	Hours/week	No. of weeks	Total hours	Semester Credits
Practical	2	14	28	01

Pre-requisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Course Objectives:

This course is intended to provide engineering students with an application of important concepts, principles of refrigeration and emphasis on those areas considered most relevant in a Refrigeration and Air-Conditioning context with practical applications in engineering and technology.

1. To impart knowledge of basic concepts in Refrigeration and implementation to various engineering fields.
2. To provide the knowledge and methodology necessary for solving problems in the field of Refrigeration and Air-Conditioning.
3. Learning the fundamental principles and different methods of refrigeration and air conditioning.
4. Study of various refrigeration cycles and evaluate performance using P-H Chart and refrigerant property tables.
5. Understand the basic air conditioning processes on psychometric charts, evaluate properties of air for its applications in comfort and industrial air conditioning.
6. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Course Outcomes:

After successful completion of this lab course the student will be able to:

1. Comprehend the performance parameters of Vapour Compression Refrigeration system and domestic refrigerator.
2. Evaluate cycle performance and actual coefficient of performance (C.O.P.) of ICE Plant.
3. Analyze the performance parameters of Vapour Absorption refrigeration system.
4. Apply the knowledge of psychrometry to various psychrometric processes in Air-conditioning system.
5. Know different types of compressors, expansion and Safety used in Refrigeration and Air-Conditioning system, charging of refrigeration system.
6. Understand the measuring instruments and various tools used in Refrigeration and Air-Conditioning Systems.

COURSE CONTENT

Refrigeration & Air Conditioning Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
		End Semester Exam (ESE): Oral	**25 marks**
Practical's:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

(Any 6 Practical) Consists of minimum Four Trial Practical.

1. Trial on Vapour Compression Refrigeration Test Rig.
2. Trial on Ice Plant Test Rig.
3. Trial on Domestic Refrigerator Test Rig.
4. Trial on Vapour Absorption Refrigeration System.
5. Trial on Air Conditioning Test Rig.
6. Trial on Heat-Pump Test Rig.
7. Study of Construction of Hermetically Sealed Compressor and Actual Viewing of a Cut Section model of the same (Reciprocating, Rotary and Car A/C Compressor).
8. Study of Evacuation and Charging of Refrigeration System.
9. Study of Measuring Instruments and Various Tools used in Refrigeration and Air-Conditioning Systems.
10. Study of Expansion Devices, Solenoid Valve and Safety Devices Used in Vapor Compression System.
11. Visit to Cold Storage/Ice Plant/ Central Air Conditioning System.
12. Case Study on Cold Storage Plant.
13. Study of Thermostat, Humidistat, dryer and Oil Separator.

Text Books:

1. Khurmi Gupta, "Refrigeration & Air- Conditioning", S Chand, New Delhi.
2. Manohar Prasad, "Refrigeration & air conditioning", New Age Publishers, New Delhi.
3. Arora, Domkundawar, "Refrigeration & air conditioning", Dhanpat rai and Sons, New Delhi.

Reference Books:

1. Arora C. P., "Refrigeration and air conditioning", TMH, New Delhi.
2. Ananthnarayanan, "Basics of Refrigeration", TMH, New Delhi.
3. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
4. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill,
5. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE: (Oral)

ESE will be based on the laboratory assignments submitted by the students in the form of journal. Evaluation will be based on the understanding and quality of lab work.

FINITE ELEMENT ANALYSIS AND SIMULATION TECHNIQUE LAB				
COURSE OUTLINE				
Course Title:	**Finite Element Analysis & Simulation Technique**	**Short Title:**	**FEAST**	**Course Code:**

Course Description:

This course introduces undergraduate students to Finite Element Analysis and Simulation Technique. The background required includes a sound knowledge of Mathematics, Strength of materials and Machine Design. The course aims at imparting knowledge of Finite Element Analysis and Simulation Technique.

	Hours/week	No. of weeks	Total hours	Semester Credits
Lecture	**2**	**14**	**28**	**03**
Practical	**2**	**14**	**28**	

Pre-requisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Course Outcomes:

After successfully completion of this course students will be able to:

1. understand the basic finite element formulation techniques.
2. derive equations in finite element methods for 1D problems.
3. derive equations in finite element methods for 2D problems.
4. derive equations in finite element methods for 3D problems.
5. understand the basic concept of Simulation and its techniques

COURSE CONTENT

Finite Element Analysis and Simulation Technique Lab		**Semester:**	**VIII**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**2 hours/week**	**End Semester Exam (ESE): Practical:**	**25 marks**
Practical's:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Unit – I:	**No. of Lectures: 04 hours**	

Introduction to Finite Element Method

Introductory Concepts: Introduction to FEM, Discretization going from part to whole approach, Physical problem, mathematical models and finite element solution, FEA as a integral part of CAD, Steps used in Finite Element Method, FEM Software's - Pre-processing, processing and post processing. Advantages and disadvantages of FEM, Types of Finite Elements.

Unit – II:	**No. of Lectures: 07 hours**	

One Dimensional Analysis

Discretization of one-Dimensional element, matrix analysis method, Derivation of Shape functions, element stiffness matrices, global stiffness matrix, application of boundary, and force vectors.

Assembly of Matrices - solution of problems in one dimensional structural analysis, Stepped and Taper Bars, Torsion of circular shaft.

Unit – III:	**No. of Lectures: 07 hours**	

Two-Dimensional Analysis

Introduction. Finite element analysis for truss element. Natural coordinates and coordinates transformations, Derivation of shape functions for triangular element. Analysis of structural vibration. Finite element formation of beams.

Unit – IV:	No. of Lectures: 06 hours	
Two-Dimensional Vector Variable Problems		
Equations of elasticity – Plane stress, plane strain problems, Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices, Jacobian matrix, stress analysis of CST element, eigen value Problems.		
Unit – V:	**No. of Lectures: 04 hours**	
Simulation Theory		
Simulation: Introduction, definition, steps used in simulation, advantage and limitations, techniques of simulation. **System models and studies:** - concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modelling, types of models, principles used in modelling, types of system studies, comparison of simulation and analytical methods, analogue computers and methods, hybrid computer		

Outline of Content: This course contains:

A.

1. Analysis of I-cantilever beam.
2. Analysing Flow in a System of Pipes.
3. Analysis of Trusses.
4. Modal Analysis of Spring-Mass System.
5. Modal Analysis of continuous System.
6. Thermal analysis of any component.
7. Stress strain analysis of any component.
8. Kinematic Analysis and simulation of slider crank Mechanism.

B.

Three assignments on syllabus

Note: Lab file should contain any five experiments by using any analysis software.

Text Books:

1. CAD/CAM and Automation by R. B. Patil, Tech max publication.
2. J.N. Reddy, an Introduction to Nonlinear Finite Element Analysis, OUP.
3. C.S. Krishnamoorthy., Finite element analysis TMH
4. J.N. Reddy, Finite element methods, McGraw hill publication ltd.

Reference Books:

1. Robert Cook, “Concept an application of Finite element analysis”
2. Klaus-Jurgen Bhate, “Finite element analysis”, PHI
3. C.S. Desai and J.F. Abel, “Introduction to finite element methods”, CBS
4. Tirupati R. Chandrupatla, “Finite element analysis” PHI.
5. Geoffery Gordon, “System simulation”
6. Narsingh Deo, “System simulation with digital computers”
7. Kenneth Lt. Huebner, “The FEM for Engineers”, Wiley India Pvt. Ltd. New Delhi

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE: (Practical)
ESE will be based on experiments performed & submitted by the students in the form of journal. Evaluation will be based on the understanding and quality of lab work.

<table>
<tr><td colspan="8" align="center">PROJECT</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE OUTLINE</td></tr>
<tr><td>Course Title:</td><td colspan="3">Project</td><td>Short Title:</td><td>PROJ</td><td>Course Code:</td><td></td></tr>
<tr><td colspan="8">Course description:</td></tr>
<tr><td colspan="8">Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.</td></tr>
<tr><td rowspan="2">Laboratory</td><td>Hours/week</td><td>No. of weeks</td><td>Total hours</td><td colspan="4">Semester credits</td></tr>
<tr><td>6</td><td>14</td><td>84</td><td colspan="4">3</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="5">Oral (OR)</td></tr>
<tr><td colspan="8">Prerequisite course(s):</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course objectives:</td></tr>
<tr><td colspan="8">1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Course outcomes:</td></tr>
<tr><td colspan="8">Upon successful completion of lab Course, student will be able to:</td></tr>
<tr><td colspan="8">1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="center">LAB COURSE CONTENT</td></tr>
<tr><td colspan="2">Project</td><td colspan="3">Semester:</td><td colspan="3">VIII</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="6">Examination scheme:</td></tr>
<tr><td rowspan="2">Practical:</td><td rowspan="2">6 hours/week</td><td colspan="4">End semester exam (ESE): (OR)</td><td colspan="2">50 marks</td></tr>
<tr><td colspan="4">Internal Continuous Assessment (ICA):</td><td colspan="2">50 marks</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.</td></tr>
</table>

Suggestive outline for the complete project report is as follows.

Abstract
Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Organization of Report
- Summary

Chapter 2. Literature Review

Chapter 3. Design & development / Experimentation & observation / Survey & Data collection

Chapter 4. Testing, Analysis & Validation / Results & discussions / Data interpretation

Chapter 5. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

STRUCTURE OF

M.E. Electronics & Telecommunication
(Digital Electronics)

W.E.F. 2010-2011

The scheme of teaching & examination as per university syllabus applicable to ME Electronics & Telecommunication (Digital Electronics) will be as follows.

STRUCTURE OF
M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
First Year Term-I

Sr. No.	Subject	Teaching Scheme Hours/week		Examination Scheme				
		L	P	Paper duration hours	Maximum marks			
					Paper	TW	PR	OR
1	Advanced Instrumentation System	3	-	3	100	-	-	-
2	Advanced Digital Signal Processing	3	-	3	100	-	-	-
3	Digital System Design	3	-	3	100	-	-	-
4	VLSI Design	3	-	3	100	-	-	-
5	Elective -I	3	-	3	100	-	-	-
6	Laboratory Practice –I	-	6	-	-	100	-	50
7	Seminar-I	-	4	-	-	100	-	-
Total		**15**	**10**		**500**	**200**		**50**
Grand Total		**25**			**750**			

List of Subjects for Elective – I

1. Parallel Computing
2. Biomedical Instrumentation
3. Wireless & Mobile Communication

STRUCTURE OF
M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
First Year Term-II

Sr. No.	Subject	Teaching Scheme Hours/week		Examination Scheme				
		L	P	Paper duration hours	Maximum marks			
					Paper	TW	PR	OR
1	Image Processing & Pattern Recognition	3	-	3	100	-	-	-
2	Embedded System Design	3	-	3	100	-	-	-
3	Microelectronics Circuit Design	3	-	3	100	-	-	-
4	Advanced Computer Network	3	-	3	100	-	-	-
5	Elective –II	3	-	3	100	-	-	-
6	Laboratory Practice –II	-	6	-	-	100	-	50
7	Seminar-II	-	4	-	-	100	-	-
Total		**15**	**10**		**500**	**200**		**50**
Grand Total		**25**			**750**			

List of Subjects for Elective – II

1. Advanced Digital Communication.
2. Artificial Intelligence
3. Modeling and Simulation Techniques

STRUCTURE OF
M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
Second Year Term-I

Sr. No.	Subject	Teaching Scheme Hours/week		Examination Scheme				
		L	P	Paper duration hours	Maximum marks			
					Paper	Term work	Practical	Oral
1	Seminar –III	-	04	-	-	50	-	50
2	Project Stage - I	-	18	-	-	100	-	-
Total		**-**	**22**	**-**	**-**	**150**	**-**	**50**
Grand Total		**22**		**200**				

STRUCTURE OF
M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
Second Year Term-II

Sr. No.	Subject	Teaching Scheme Hours/week		Examination Scheme				
		L	P	Paper duration hours	Maximum marks			
					Paper	Term work	Practical	Oral
1	Project Seminar	-	-	-	-	50	-	-
2	Project Stage - II	-	18	-	-	150	-	100
Total		**-**	**18**	**-**	**-**	**200**	**-**	**100**
Grand Total		**18**		**300**				

Grand Total : 2000

M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
First Year Term-I

Subject Laboratory Practice-I

Practical: 6 Hrs Per week	**Term work:** 100 Marks **Oral:** 50 Marks

Detailed syllabus

Experiment/ Assignments based on

1. Advanced Instrumentation System
2. Advanced Digital Signal Processing
3. Digital System Design

Note: The concern subject incharge in consultation with H.O.D, should frame minimum of six laboratory assignments, two from each subject.

Subject Seminar-I

Practical: 4 Hrs Per week	**Term work:** 100 Marks

Detailed syllabus

Seminar on related state of art topic of students of own choice approved by the department.

Term work

The Term work and presentation will be evaluated by departmental committee consisting of two faculty members of the department appointed by Principal as per the recommendation of the Head of the Department.

M.E. ELECTRONICS AND TELECOMMUNICATION (DIGITAL ELECTRONICS) First Year Term-II	
Subject Laboratory Practice-II	
Practical: 6 Hrs Per week	**Term work:** 100 Marks **Oral:** 50 Marks
Detailed syllabus	
Experiment / Assignments based on 1. Image Processing & Pattern Recognition 2. Embedded System Design 3. Advanced Digital Communication. **Note:** The concern subject incharge in consultation with H.O.D, should frame minimum of six laboratory assignments, two from each subject.	
Subject Seminar-II	
Practical: 4 Hrs Per week	**Term work:** 100 Marks
Detailed syllabus	
Seminar on related state of art topic of students of own choice approved by the department. **Term work** The Term work and presentation will be evaluated by departmental committee consisting of two faculty members of the department appointed by Principal as per the recommendation of the Head of the Department.	

M.E. ELECTRONICS AND TELECOMMUNICATION
(DIGITAL ELECTRONICS)
Second Year Term-I

Subject Seminar –III

Practical: 4 Hrs Per week	**Term work:** 50 Marks **Oral:** 50 Marks

Detailed syllabus

Seminar on special topic. The topic should be on any of the area not included in the regular curriculum. The report should include detailed study of specific concept (i.e analysis, design and implementation). This can be a theoretical study or practical implementation approved by the guide and department.

Term work

1. Seminar III should be conducted at the end of Second Year Term-I
2. The term-work of the Seminar-III will be evaluated by departmental committee consisting of guide and two faculty members of the department appointed by Director / Principal of the college as per the recommendation of the Head of the Department.
3. The Seminar-III presentation will be evaluated by the examiners appointed by University, one of which should be guide.
4. Student must submit the seminar report in the form of soft bound copy.
5. The marks of seminar-III should be submitted at the end of the Second Year Term-I to the University.

Subject Project Stage-I

Practical: 18 Hrs Per week	**Term work:** 100 Marks

Detailed syllabus

Project stage-I It is the integral part of the dissertation project. The project should be based on the knowledge acquired by the student during the course work and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building, complete system or subsystem in an area where the student like to acquire specialized skills. Project will consist of a system development in Software/ Hardware. The student should present the progress report of the project. It will consist of problem statement, literature survey; project overview and scheme of implementation.

Term work

The term-work of the project stage-I will be evaluated by departmental committee consisting of guide and two faculty members of the department appointed by the Director/Principal of the college as per the recommendation of the Head of the Department.

M.E. ELECTRONICS AND TELECOMMUNICATION (DIGITAL ELECTRONICS) Second Year Term-II	
Subject Project Seminar	
	Term work: 50 Marks

1. The Project Seminar should be conducted at the middle of Second Year Term-II
2. The Project Seminar term-work will be evaluated by departmental committee consisting of guide and two faculty members of the department appointed by Director / Principal of the college as per the recommendation of the Head of the Department.
3. Student must submit the Project Seminar report in the form of soft bound copy.
4. The marks of seminar-III should be submitted at the end of the Second Year Term-I to the University.

Subject Project Stage-II	
Practical: 18 Hrs Per week	**Term work:** 150 Marks **Oral:** 100 Marks

Detailed syllabus

This is continuation of Project Stage-I. The complete system development in software / Hardware carried out using Electronics and Telecommunication Engineering principles and practices is expected. It should be working system either software or hardware or combination of both.

He/ She has to present / publish atleast one paper in reputed National / International Journal/ Conference on his/ her project work before submission of his / her Thesis/ Dissertation.

Term work

1. The term-work of the Project Stage-II will be evaluated by departmental committee consisting of guide and two faculty members of the department appointed by Director / Principal of the college as per the recommendation of the Head of the Department.
2. The Project Stage-II oral will be evaluated by the examiners appointed by University, one of which should be guide.

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
W.E.F : 2010-11
Term – I

ADVANCED INSTRUMENTATION SYSTEM

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Digital Instruments:- Introduction, Digital Panel Meters, Digital Frequency Meters, Basic Circuit for Frequency measurements, High Frequency measurements, Digital Measurements of time, Period Measurement, Ratio and Multiple Ratio Measurement, Universal Counter, Digital Measurement of Mains Frequency.

Signal Analyzer :- Wave Analyzer, Harmonic Distortion Analyzer, Spectrum Analyzer, Network Analyzer, Logic Analyzer, Protocol Analyzer.

PC Based Data Acquisition System: - PC Based Instrumentation System, Introduction to PC Based Data Acquisition System.
Introduction to Smart Sensors:- Digital Sensors, Case Studies of Real Time PC Based Instrumentation System, Virtual Instruments, Intelligent Instruments.

Automated Measurement System :- Need And Requirement Automatic Test Equipments (ATE) Computer Based And Computer Controlled ATE Switches in ADTE , ATE For PCB Testing, ATE for Component Testing, IEEE- 488 Electronic Instruments BUS Standards.

Computer Control :- Hierarchy of Computer Control For Industry , Direct Digital Control, Distributed Digital Control, Supervisory Control And Data Acquisition System (SCADA), NC, CNC.

Introduction to process control :- Control System, Process Control Principles, Servo mechanism, Discrete Control System, Process Control Block Diagram , Anlog and Digital Processing , Feedback Control, Basic Principle of Single Loop Controller , Two Position Control, Mutiposition Control, Proportional ,Integral , Derivative Controller (Overview), Multivariable Control , Cascade Control, Ratio Control , Feed Forward Control.
Control Modes:- Close loop Response , Control loop transfer function, Analysis of Chemical Reactor.

Intelligent Controller :- Programmable Logic Controller, PLC Programming Technique , Fuzzy Logic Controller.
Industrial Control Application:- Cement Plant , Thermal Power Plant, Irrigation Cannal Management, Steel Plant.

References :

1. Clyde E. Coombs, Electronic Instruments Handbook(3/e), McGraw Hill International.
2. Mc Lachlan & Buchla, Applied Electronic Instrumentation & Measurement , 1992, Prentice Hall International..
3. Pallas Areny & Webstor, Sensors & Signals Conditioning , (2/e)1994, J.Wiley & sons
4. Critis Johnson, Process control Instrumentation Technology, PHI
5. H.S.Kalasi, Electronic Instrumentation (2/e), Tata McGraw Hill International
6. Bela G. Liptak, Butterworth Heinemann, Instrument Engineer's Handbook (3/e) Process Control,
7. Aibert D. Helfric, William D. Cooper, Modern Electronic Instrumentation And Measurement Technique
8. Krishna Kant, Computer Based Industrial Control.

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
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Term – I

ADVANCED DIGITAL SIGNAL PROCESSING

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Discrete time signal & systems, its representation, types of discrete time system,DFT, IDFT, FFT(DIF&DIT). Realization of FIR and IIR filter

Multirate digital signal processing-decimation by factor D, interpolation, filter design & implementation, sampling rate conversion, application of multirate signal processing.

Power spectral estimation- parametric & nonparametric method for power spectral estimation, minimum variance, and realization of FIR & IIR filters.

Least mean square Adaptive filter: Overview of the structure, operation of the LMS algorithm, LMS adaptive algorithm, statistical LMS theory, Comparison of the LMS algorithm with the steepest Descent algorithm, Computer experiment on adaptive prediction, Computer experiment on adaptive equalization, Computer experiment on a minimum- variance distortion less response beam former, Directionality of convergence of the LMS algorithm for Nonwhite Inputs, Robustness of the LMS filter, Upper bound on the step size Parameters for Different Scenarios, Transfer function approach for deterministic input summary problems.

Design of digital filters-symmetric & antisymmetric, linear phase, optimum, Equiripple, FIR differentiation, Hilbert's transformers.

Design of IIR filters-impulse invariance, bilinear transformation, matched transformation, frequency transformation in analog & digital domain.

Design of digital filters based on least square method.

Application of DSP to speech processing & radar signal processing.

Introduction to TMS320c62XX DSP processors.

References :

1. John Proakis, Digital Signal Processing Prentice Hall
2. A.V.Oppenhiem & R.W.Schafer, Digital Signal Processing - Prentice Hall
3. L.R.Rabiner & B.Gold,Theory & application of digital signal processing- Prentice Hall
4. A.Antiniou, Digital Filters; analysis, design & application- Mcgraw Hill
5. Salivahanan,vallavaraj,gnanapriya, Digital Signal Processing-TMH
6. S.K.Mitra, Digital Signal Processing - TMH

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
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Term – I

DIGITAL SYSTEM DESIGN

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode. Essential hazards Unger's theorm. Map entered variable and synthesis of random logic. Fault detection and error correction.
Register- transfer level systems, Execution Graph, Organization of System, Implementation of RTL Systems, Analysis of RTL Systems, Design of RTL Systems.
Data Subsystems, Storage Modules, Functional Modules, Data paths, Control Subsystems, Micro programmed Controller, Structure of a micro programmed controller, Micro instruction Format, Micro instruction sequencing, Micro instruction Timing, Basic component of a micro system, memory subsystem.
I/O subsystem, Processors, Operation of the computer and cycle time. Binary Decoder, Binary Encoder, Multiplexers and Demultiplexers, Floating Point Arithmetic-Representation of Floating Point Number, Floating Point Multiplication.
Logic simulation: General fault simulation techniques, statistical fault analysis. Testing for single stuck fault: Basic issues, ATG for SSF in combined circuits. ATG for SSFs in sequential circuits. PLA testing.
Design for Testability: Classical testability scan design, compressing tech. built in self test logic level diagnosis, self checking design.
Specific digital system: Deign such as digital IS tester Microcontroller cards, PC add on cards design, PLA based product design.

References:

1. M. Ercegovac, T. Lang and L.J. Moreno, "Introduction to Digital Systems", Wiley,2000
2. John F. Wakerly,"Digital Design principles and practices",3rd edition, PHI publications.
3. Melvin A Breuer, Arthur D Friedmen, MironAbra MOVICI jaico Publishing.
4. House- Digital system testing and testable design.
5. B Holdsworth Digital Logic Design.
6. Puri V.K Digital Electronics
7. Z. Navabi, " VHDL-Analysis and Modeling of Digital Systems", TMH

8. Norman - Digital Logic design principal John Wiley Pub.
9. Samual – Digital Circuit logic design –PHI.
10. Charles H. Roth, ”Digital system design using VHDL”, Thomson Publication.
11. Balabanian,”Digital logic design principles”,Wiley publication.
12. Stephen Brown, “Fundamentals of digital logic”, TMH publication.

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
W.E.F : 2010-11
Term – I

VLSI DESIGN

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Review of VHDL Verilog Programming, Hardware modeling with Verilog / VHDL, different verilog /VHDL constructs, and Logic Synthesis. Levels of abstraction, Elements (Data flow, Behavioral, Structural, Mixed and switch level Description).

simulation process, types of simulators FSM modeling, test benches, generics & attributes, synthesis tools features & optimization in VHDL, Synthesis guidelines, Timing issues: terminology, flow diagram, clock, gated clock, setup & hold time, violation,Meta stability, Static & Dynamic timing analysis.

CMOS & Bi-CMOS logic families & PLD architecture, Power dissipation, noise and ESD issues, clock distribution, signal connections, synchronous and asynchronous design features, and memory system design. CMOS systems Design, CMOS Testing. Classification of CPLD architecture, CPLD 9500 series, Xilinx FPGA –XC4000 series,

Designing steps in ASIC, Physical Design flow, Different type of ASIC, CAD Tools, System Partitioning, Estimating ASIC size, Power dissipation, FPGA partitioning methods,

Floor planning, Placement Physical design flow; Information Formats; global routing, detailed routing; special routing; circuit extraction and DRC

References :

1. Douglas Perry, VHDL - McGraw Hill Publication
2. Janic Bergerson, VHDL Using Testbenches
3. Yu. Chin Hsu, K. Tsai, VHDL Modeling for Digital Design Synthesis.- Kluwer publishers.
4. Xilinx PLD data manual
5. Michael John sebastiab smith, “Application specific IC”, Addison Wesley publication.

6. K. K. Parhi , “VLSI Digital signal processing systems Design & Implementation” John Wiley & Sons
7. Neil Weste and Eshraghian, “Principles of CMOS VLSI Design “(Second Edition) Pearson Education Asia (Addison – Wesley Publication Company)
8. James E Buchnan – BiCMOS-CMOS system design McGraw Hill Publication.

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M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
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Term – I

Elective – I

PARALLEL COMPUTING

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Parallel Computer Models: The state of computing, Multiprocessors and multi-computers, Multivector and SIMD computers, Architectural development tracks
Program And Network Properties: Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus data flow, Data flow architecture, Demand driven mechanisms, Comparisons of flow mechanisms
System Interconnect Architectures: Network properties and routing, Static interconnection networks, Dynamic interconnection Networks, Multiprocessor system interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.
Processors and Memory Hierarchy: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors Memory Technology: Hierarchical memory technology, Inclusion, Coherence and Locality, Memory capacity planning, Virtual Memory Technology.
Backplane Bus System: Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt, Cache addressing models, direct mapping and associative caches.
Pipelining: Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline Design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipelines.
Vector Processing Principles: Vector instruction types, Vector-access memory schemes.
Synchronous Parallel Processing: SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, SIMD Computers and Performance Enhancement

References:

1 Kai Hwang, "Advanced Computer Architecture", Parallelism, Scalability, Programmability", McGraw Hill Inc. Ed. 1993.
2 V. Rajaranam & C.S.R.Murthy, "Parallel Computer"; PHI.
3 William Stallings, "Computer organization & Architecture", PHI, New Delhi, 6th edition.
4 Dezso'Sima, "Kalsuk'Advanced computer Architectures", Terence Fountain & Peter Pearson's Edation. (2nd Edition)
5 Hwang and Degroot, "Parallel Processing for Supercomputers and AI", (Eds) McGraw Hill.
6 J. P. Hayes, "Computer Architecture And Organization"; MGH.
Harvey G. Cragon, "Memory System and Pipelined Processors"; Narosa Publication.
7 R. K. Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publications. Kai Hwang and Zu, "Scalable Parallel Computers Architecture"; MGH.

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
W.E.F : 2010-11
Term – I

Elective - I

BIOMEDICAL INSTRUMENTATION

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Measuring, Recording and Monitoring Instruments

Anatomy and Physiology, Physiological Systems of the Body, Basic Medical Instrumentation System, Performance Requirements of Medical Instrumentation System, Intelligent Instrumentation System, General Constraints in Design of Medical Instrumentation System, Regulation of Medical Devices.

Physiological transducers: Displacement, position and motion transducers, Pressure transducers, Transducers for Body Temperature Measurement, Photoelectric transducers, Optical Fibre sensors, Biosensors

Recording systems: Basic Recording systems, Biomedical signal Analysis Techniques, Signal Processing Techniques, Potentiometric Recorders, Digital Recorders, Instrumentation tape Recorders,

Biomedical Recorders: Electrocardiograph, Vectorcardiograph (VCG), Phonocardiograph (PCG), Electroencephalograph (EEG), Electromyograph (EMG), Other Biomedical Recorders, Biofeedback Instrumentation

Patient Monitoring Systems: Bedsides Patient Monitoring Systems, Central Monitors, Measurements of Heart Rate, Measurements of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration rate

The Matched Filter, Detection of the P Wave,Homomorphic Filtering, Application- ECG Rhythm Analysis, Identification of Heart Sounds, Waveshape and waveform Complexity, Analysis of Event-related Potentials, Morphological Analysis of ECG Waves, Envelope Extraction and Analysis of Activity, Application- Normal and Ectopic ECG Beats, Analysis of Exercise ECG.

Modern Imaging Systems: X-ray Machines and Digital Radiography Portable and mobile X-ray units, Digital Radiography, X-ray Computed Tomography, Computed Tomography, System components, Gantry Geometry, Patient Dose in CT Scanners, Nuclear Medical Imaging System, Radiation Detectors, Pulse Height Analyzer, Uptake Monitoring Equipment, Radio-isotope Rectilinear Scanner, The Gamma Camera, Emission Computed Topography (ECT) Single Photon Emission Computed Topography (SPECT), Positron Emission Topography (PET scanner)
Ultrasonic Imaging Systems: Diagnostic Ultrasound, Medical Ultrasound, Basic Pulse-echo Apparatus, A-Scan, B-Scanner.
Laser Applications In Biomedical Field: The laser, Pulsed Ruby laser, ND-YAG laser, Helium –Neon Laser, Argon Laser, CO2 Laser, Excimer Lasers, Semiconductors Laser, Laser Safety

References:

1. Cromwell - Biomedical Instrumentation, Pearson
2. Khandpur - Handbook of Biomedical Instrumentation
3. Webster - Biomedical Instrumentation, Wiley
4. R. M. Rangayyan “Biomedical Signal Analysis- A case study approach”, Wiley Publications.
5. Eugene N Bruce “Biomedical signal processing and signal modeling”, Wiley publications.

NORTH MAHARASHTRA UNIVERSITY JALGAON
M.E. ELECTRONICS AND TELECOMMUNICATION (Digital Electronics)
W.E.F : 2010-11
Term – I

Elective - I

WIRELESS & MOBILE COMMUNICATION

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Basics: History of wireless communication, and future trends, Wireless Generations and Standards, Cellular Concept and Cellular System Fundamentals, Trunking Cell Splitting and Sectoring, Mobile Radio signal propagation, path loss and channel models.

Speech coding for wireless system and application like PCM, DPCM, DM, Vocoder & Linear Predictive coding. Performance comparison.

Wireless LAN
IEEE802-11Hiper LAN, Bluetooth, Adhoc Network: Characteristic, Performance issue, Routing in mobile host.

Wireless Networking:
Difference between wireless & fixed telephone n/w, development, transmission hierarchies, traffic routing, wireless data services, common channel signaling, ISDN, SS7, global cellular network, Interoperability, PCS/PCNs, Protocols for n/w access and n/w data base, UMTS.

Wireless systems and standards:
AMPS, ETACS, United state of digital cellular, (IS 54 and IS 136) GSM, CDMA (IS95), CT2 Standards for cordless telephone, Digital European cordless telephone , PACs, PDC, Personal handy phone systems, US PCS & ISM bands, US wireless cable TV, IEEE802.11.

References:

1. Walker, J.: Mobile Information Systems. Artech House, Inc. 1990, Boston London
2. Mehrotra, A.: GSM System Engineering. Artech House, Inc. 1997, Boston London

3. Redl, S.M., Weber, M.K., Oliphant, M.W.: An Introduction to GSM. Artech House, Inc. 1995, Boston London
4. Feher, Wireless Digital Communication- 1991, PHI.
5. Vijay K. Garg, and J.E. Wilkes, Principles & applications of GSM –1999 – Prentice hall PTR.
6. Roger L. Freeman, Telecom Transmission handwook 4th ed 1998 John Wiley & Sons. Inc. New York.
7. Lee, Mobile Cellular Telecomm, 1995 Mc Graw Hill Inc.
8. J. Schiller, Mobile Communication, Addision Wiley
9. William C.Y. Lee, Mobile Comm. Design Fundamental. John wiley.
10. Mark Ceampa, Design & Implementation of Wireless LANs, Thomson Learning.

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IMAGE PROCESSING AND PATTERN RECOGNITION

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Digital Image fundamentals : Basic Image Processing steps, image acquisition, presentation of gray scale and modeling. Human visual perception, sampling and quantization, basic relationships between pixels. Histogram analysis and equalization, geometric image

Applications of pattern recognition, statistical decision theory, image processing and analysis.
Probability: Introduction, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators Statistical Decision Making: Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one—out technique. Characteristic curves, estimating the composition of populations.
Nonparametric Decision Making: Introduction, histograms, Kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminate Functions, minimum squared error discriminate functions, choosing a decision making technique.
Clustering: Introduction, hierarchical clustering, partitional clustering Artificial Neural Networks, PCA, ICA, SVM.

References:

1) R. C. Gonzalez & Woods, "Digital Image Processing" – Addison Wesley IIIrd Ed.
2) A. K. Jain, "Fundamentals of Digital Image Processing"– Prentice Hall Inc.
3) Robert Jschalkoff, "Digital Image Processing & Computer vision : An introduction to theory & Implementation"– John wiley & Sons Inc.
4) K. R. Castleman, "Digital Image Processing" – PHI
5) W. K. Pratt, "Digital Image Processing" .(3 Ed.) John.Wiley.
6) B. Chanda and D.Mujumdar,"Digital Image Processing & Analysis".-PHI, New Delhi, 2000.

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Term – I I

EMBEDDED SYSTEM DESIGN

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Embedded system Introduction:
Introduction to Embedded System, History, Design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols like SPI, SCI, I2C, CAN etc

System Architecture:
ARM7/ARM9 architecture, instruction set, thumb Instruction set, Pipeline, memory management, Bus architecture, Programming concepts, Embedded programming in c and C++.

Multiprocessors Scheduling: Model of multiprocessor & distributed systems, Multiprocessor priority ceiling protocol, Elements of scheduling algorithms for end-to-end periodic tasks, Schedulability of fixed priority end-to-end periodic tasks, end-to-end tasks in heterogeneous systems.

Real Time systems: Characterizing real time systems & tasks, Performance measures, Estimating program runtimes, Task assignment & scheduling, Real time operating systems (RTOS), Task management, Race condition, Inter-task communication, Implementation aspects & estimation modeling in embedded systems, Validation & debugging of embedded systems, Real time communication, Hardware-software co-design in an embedded system, Applications of Real time systems.

References:
1. Krishna & Shin, Real -Time Systems, (McGraw Hill International)
2. Rajkamal, Embedded systems, (Tata - McGraw Hill)
3. Valvano, Embedded Microcomputer systems, (Thomson Delmar publishing)
4. Atmel/ARM Data books.
5. Iyer &Gupta, Embedded Real Time Systems Programming, (Tata McGraw Hill)

6. Lewis Daniel, Fundamentals of Embedded software, (Prentice Hall India)
7. Jane Liu, Real Time Systems, (Pearson India low cost edition)

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Term – I I

MICROELECTRONICS CIRCUIT DESIGN

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Types of modeling, Models of diode, BJT and FET, CMOS device modeling: Simple MOS Large-signal Model, Simple MOS Small-signal Model,
Analog IC Design : Differential Amplifier, Cascode Amplifer, Current Amplifiers, Output Amplifers, High gain amplifier Architecture,
Operation Amplifier Design of CMOS op-amp, Compensatio of op-amps,
Design of two stage op-amps, PSRR of two stage op-amps, Cascode op-amps, Simulation and Measurement of Op-amps, Micromodels of Op-amps, Switch Capacitor Circuits, Switch Capacitor Amplifiers, Switch Capacitor Integrator, z Domain Models of two phase switched capacitor circuits, First and Second order switched capacitor circuits, Switched capacitor filter.
High frequency amplifier, Mixer, R.F. Power amplifier, Phase- Locked Loops.

References:

1) Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design,2nd ed. New York : Oxford University Press, 2004
2) Thomas H. Lee, “The Design of CMOS Radio – Frequency Integrated Circuit”, Cambridge University Press
3) B. Razavi “RF Microelectronics” PHI 1998
4) R. Jacob Baker, H.W. Li, D.E. Boyce “ CMOS Circiut Design, layout and Simulation” PHI 1998
5) Y.P. Tsividis “Mixed Analog and Digital Devices and Technology” TMH 1996

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Term – I I

ADVANCE COMPUTER NETWORK

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Review of computer networking concepts

Topology, LAN, WAN, MAN, Internet, OSI/ISO, TCP/IP reference models, Point to point protocols. ARQ: Retransmission strategies. Functional elements : Multiplexing, Switching , Networks Management & traffic controls. Delay models in Data Networks Switching techniques: Performance measures & architectural issues.

Internetworking

TCP/IP Internet architecture, IPV4, IPV6, IP addressing & related issues, IP address resolution techniques (ARP). IP datagram & forwarding, routing algorithms.

Multiple access techniques

ALOHA, CSMA, CSMA/CD, CSMA/CA, CDMA, OFDM, Delay throughput characteristics, WLAN-Protocols, multiple access, Ad-hoc networks, Bluetooth Specifications, WAP.

Network security issues

Ciphers, DES, Public key cryptography, RAS algorithm, Digital Watermarking, Attacks and Counter Measures , Service Authentication Performa.

References:

1) Dimitri Bertisekas & Robert Gallager, “Data Networks” PHI
2) Gerd E Kieser, “Local Area Networks”,– Mc-Graw-Hill
3) D.E.Comer, “Computer Networks and Internetworking” Pearson Education
4) William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson Education
5) Steele, “GSM, CDMA and 3G Systems” , Wiely Students Edition
6) Anurag kumar, D. Manjunath & Joy Kuri– Morgn, “Communication Networking” An analytical approach” – Kaufmann publishers

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Term – II

Elective - II

ADVANCED DIGITAL COMMUNICATION

Teaching scheme:
Lectures: 3 hrs / week

Examination scheme:
Theory Paper : 100 Marks (3 Hours)

Signal spectra & Random Processes:
Basics of Fourier series & Fourier transform, Probability, Random Variables and processes, Digital PAM & PAM formats, Line coding spectral representation, AT & T and CCITT hierarchies.

Digital CW modulation an overview, BPSK, DPSK, DEPSK, OPSK, M'ary PSK, QASK constellation pattern, BFSK, GMSK, Doubinary encoding, QPR coherent & non coherent systems, Bandwidth & spectrum representation, error probabilities in BPSK, DPSK, QPSK, FSK, 16 QAM, MSK, their performance evaluation in presence of AWGN.

Matched correlation, optimum filters, Integrate & Dump, their transfer function, error probabilities, error rate etc.

Spread spectrum techniques: DS, FH, CDMA based system, Performance of DS-SS & FH-SS, generation of PN sequence code.

Error Control Coding**:** Introduction to algebra**,** Group rings, Galois field, two arithmetic GF, Linear block codes: Structure matrix description, Syndrome decoding, Hamming codes, Perfect & Quest, perfect odes, Cyclic codes: Polynomial description, division algorithm, matrix description, fire codes, golay codes, cyclic Redundancy check codes, circuit implementation of cyclic codes.

Encoding and Decoding of BCH and RS codes, MDS Codes, Nested codes, Convolutional Encoders, Tree & Trellis diagram, Veterbi decoding algorithms, Sequential decoding algorithms.

References :

1. J. G. Prokais, "Digital Communications", McGraw Hill Inc.

2. Bernad Sklar, “Digital Communication: Fundamentals & Applications”, Pearson Education Asia (LPE).
3. A. B. Carlson, “Communication System”, Mc Graw Hill Inc.
4. Amitabh Bhattacharya, “Digital Communication”, TMH.
5. T. S. Rappaport, “Wireless Communication”, Pearson Education.
6. Simon Haykin, “Digital Communications”, John Wiley & Sons
7. Taub &Schilling, “Principle of Communication System”, TMH.

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Term – I I

Elective - II

ARTIFICIAL INTELLIGENCE

Teaching scheme:	Examination scheme:
Lectures: 3 hrs / week	Theory Paper : 100 Marks (3 Hours)

Fuzzy Logic Introduction to Fuzzy sets, Fuzzy set Theory, Fuzzy relation, Membership functions, fuzzification, defuzzification, fuzzy rule based system fuzzy inference system.

Fuzzy Decision Making, Fuzzy modeling, Fuzzy reasoning, compositional rules of inference, Fuzzy systems as function estimators, Fuzziness as multivalence, Adaptive neuro fuzzy inference system, cognitive neurofuzzy modelling, Neuro fuzzy control, Application of neuro fuzzy control

Neural Network Fundamental of Artificial Neural Network : Artificial Neuron model. Learning process, Single layer and multilayer feed forward network, training by back propagation, Hop-field model basic concept of
Bidirectional associative memory, self organization map, optimization model.
Recurrent Networks, Hamming Net and MAXNET, Feature mapping, counter propagation networks, cluster discovery Network (ART),
Applications of Neural Network Characters Recognition Network, Neural Network control Application, Network for Robot kinematics, Hand written Numeral recognition.

References:

1 Limin Fu , “Neural Networks in Computer Intelligence”, McGraw Hill Inc., 1994.
2 N. K. Bose, P. Lling , “Neural Network Fundamentals”, McGraw Hill.
3 Zurada “Artificial Neural Networks”,
4 Timothy J. Ross , “ Fuzzy Logic with Engg. Applications”, McGraw Hill.
5 Jang, Sun, Mezutani “Neuro Fuzzy and Soft computing”, TMH
6 Bart Kasko, “Fuzzy Engineering”, PHI
7 S. Hykin , “Neural Networks”, Pearson Education.
8 J.A.Freeman and B.M.Skapure, “Neural Networks, Algorithms Applications and programming Techniques”, Addison – Wesely, 1990

9 Laurence Fausett, “Fundamental of Nerual Networks: Architecture, algorithms and application”,Prentice Hall, 1994.

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Term – II

Elective - II

Modeling and Simulation Techniques

Teaching scheme: Examination scheme:
Lectures: 3 hrs / week Theory Paper : 100 Marks (3 Hours)

Introduction Models and their applications, Common types of mathematical models used for engineering systems, Derivation of models from physical relations, Model determination from input- output observation, Basic principle of simulation, Analog and digital simulation techniques, Models: Structural, Process, Continuous, Discrete, Deterministic,Random, input/output, static, dynamic, multilevel.

Classical and Semi-classical models:
Boltzmann transport equation, classical semiconductor equations- drift diffusion approximation, generation and recombinations, different generation and recombination mechanisms, limitations of drift-diffusions, energy transport, semiclassical and hot electron models, hydrodynamic and semi-classical semiconductor equations, modeling of semiconductor laser diode, general aspects, static models and dynamic models, model verification and validation.

Numerical Techniques: Finite difference methods, first order and second order derivatives and discrimination, finite element method, solution of poison's equation, solution of steady state continuity equation for electrons and holes, advantages and disadvantages of finite element method, Monte Carlo simulation techniques, basic concepts, Random variables, random number generation and testing, analysis of simulation results, confidence intervals, variance reduction techniques. Case studies of analytical and simulation studies

Modeling of Semiconductor Devices p-n junction, p-n junction C-V characteristics, breakdown, Schottky diodes, Hetero-structure diodes, Simulation of above device characteristics in graphical format, Simulation of simple laser diode and plot its characteristics by considering appropriate materials and parameters, PIN diode, Avalanche Photodiode, Quantum transport modeling, 1D models, discretized Schrodinger equation, Transmission matrix formation, I-V characteristics.

Universal FET modeling

sub threshold regime, unified charge control model, short channel effects, I-V modeling.Capacitance modeling (Ward Dutton and Meyer models) Universal models for MOSFET,MESFET, HFET and TFT.

References:

1. Modeling of CMOS G.Gordon, 'System Simulation', 2nd ed., Prentice Hall
2. Narsing Deo, 'System Simulation with Digital Computers', Prentice Hall
3. R. Leigh, 'Modelling and Simulation', Peter Peregrims Ltd.,. 1983.
4. M.Law, W.D.Kelton, 'Simulation Modelling and Analysis, Mcgraw Hill, 1982.
5. Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley and Sons, New York, USA, 1991
6. Trivedi, K.S, Probability and Statistics with Reliability, Queueing and computer science Applications, Prentice Hall of India, Reprinted in 1990.