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

Third Year Engineering
(Computer Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – V&VI

W.E.F. 2020 – 21

Syllabus Structure for Third Year Engineering (Semester – V) (Computer) (w.e.f. 2020 – 21)
(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		
Database Management Systems **	D	3	-	-	3	40	60	-	-	100	3
Software Engineering **	D	3	-	-	3	40	60	-	-	100	3
Formal Language and Automata Theory**	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – I	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – I	F	3	-	-	3	40	60	-	-	100	3
Database Management Systems Lab**	D	-	-	2	2	-	-	25	25 (PR)	50	1
Software EngineeringLab**	D	-	-	2	2	-	-	25	25 (OR)	50	1
Web Programming Language Lab **	D	-	-	2	2	-	-	25	25 (PR)	50	1
Minor Project (Stage – I) **	G	-	-	6	6	-	-	50	-	50	3
Constitution of India **	H	-	-	-	-	-	-	-	-	-	-
		15	**0**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

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

Professional Elective Course – I		Open Elective Course – I	
1	Artificial Intelligence **	1	Operations Research**
2	Advanced Computer Architecture **	2	Renewable Energy Sources **
3	Computer Graphics	3	Cyber Law and Ethics**
4	Information Theory and Coding	4	E-waste Management**

****** Common subjects with T.E. I.T.

Syllabus Structure for Third Year Engineering (Semester – VI) (Computer) (w.e.f. 2020 – 21)
(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		
Operating Systems**	D	3	-	-	3	40	60	-	-	100	3
Computer Networks**	D	3	-	-	3	40	60	-	-	100	3
Design and Analysis of Algorithms**	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – II	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – II	F	3	-	-	3	40	60	-	-	100	3
Operating Systems Lab**	D	-	-	2	2	-	-	25	25 (PR)	50	1
Computer Networks Lab**	D	-	-	2	2	-	-	25	25 (PR)	50	1
Design and Analysis of Algorithms Lab **	D	-	-	2	2	-	-	25	-	25	1
Minor Project **	G	-	-	6	6	-	-	50	25 (OR)	75	3
Internship – II *	H	-	-	-	-	-	-	-	-	-	-
		15	**0**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

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

Professional Elective Course – II		Open Elective Course – II	
1	Neural Networks **	1	Project Management**
2	Embedded Systems**	2	Managing Innovation and Entrepreneurship**
3	Image Processing	3	Supply Chain Management-Planning**
4	Software Metrics & Quality Assurance	4	Information Sources and Literacy**

* Internship - II is a mandatory and non-credit course. It shall be during summer vacation after Semester – VI. The satisfactory completion of Internship should be submitted to University at the end of Semester – VIII.

****** Common subjects with T.E. I.T.

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COURSE OUTLINE
Semester - V
W.E.F. 2020 – 21

Database Management Systems					
COURSE OUTLINE					
Course Title:	**Database Management Systems**	**Short Title:**	**DBMS**	**Course Code:**	

Course description:

The aim of this course is to introduce the student, the fundamental concepts of database management systems. Topics include data models, query languages, Relational Database design, Transaction management and database system architectures. Students will able 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):

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 modelling, 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 successful completion of this courseStudents will be able to

1. Explain the basics of Database Management System and develop the entity relationship diagram for any database application.
2. Construct the queries using Formal Relational Query Languages.
3. Construct the queries using Structured Query Language and explain the working of Function, Procedure and Triggers.
4. Identify and apply normalization methods on database, along with understanding of indexing basic concepts.
5. Discuss the concept of transaction, concurrency, recovery and various database system architectures.

COURSE CONTENT

Database Management Systems		Semester:	V
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 DBMS 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, Semistructured 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	**No. of Lectures: 08 Hours**	**Marks: 12**	
Formal Relational Query Languages **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 **The Tuple Relational Calculus:** Formal Definition, Example Queries **The Domain Relational Calculus:** Formal Definition, Example			
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**	
Structured Query Language 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	**No. of Lectures: 09 Hours**	**Marks: 12**	
Storage strategies and Relational Database Design **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	**No. of Lectures: 09 Hours**	**Marks: 12**	

Transaction Management and Architectures

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.

Software Engineering					
COURSE OUTLINE					
Course Title:	**Software Engineering**	**Short Title:**	**SE**	**Course Code:**	

Course description:

The Software Engineering course is aimed to provide students with different aspects of Software Engineering and UML including requirements identification, behavioral and structural design with UML diagrams. Students will also become familiar with the real-life software development process.

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

Prerequisite course(s):

Knowledge of programming languages, data structures and object oriented technology.

Course objectives:

1. Students will understand the discipline of software engineering and its application to the development and management of software systems.
2. Students will learn basic software engineering methods & practices and their appropriate applications.
3. Students will understand the principles of analysis and design for software development.
4. Students will think about applications to construct software of high quality which is reliable yet reasonably easy to understand, modify and maintain.

Course outcomes:

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

1. Define basic concepts of software engineering
2. Describe software requirements.
3. Illustrate the design of software.
4. Test developed software for requirements validation.
5. Outline software project planning activities and schedule them for project execution.

COURSE CONTENT

Software Engineering		Semester:	V
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 Software Engineering

The evolving role of software, What is software engineering: definition, Software characteristics, Software engineering terminologies, Software life cycle models: The Waterfall, Prototyping and Spiral Model, The Unified Process, Selection of life cycle model

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Software Requirements : Analysis and Specification Requirement engineering, Feasibility studies, Functional & non-functional requirements, Requirements elicitation, Requirements Analysis, Organization of SRS		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Software Design What is Design?, Modularity: cohesion & coupling, Function oriented design: DFD & Structure chart, Object modeling using UML: Overview of UML, UML diagrams, Use Case model, Class diagram, Interaction diagram, Activity diagram, State Chart diagram, Package, Component & Deployment diagrams		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Coding and Software Testing Coding: standards & guidelines, Code review, A strategic approach to software testing, Testing terminologies, Functional (Black Box) testing, Structural (White Box) testing, Levels of testing, Validation testing, Testing tools, Software reliability, Software quality		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Software Project Planning & Management Size estimation, Cost estimation, The CoCoMo model, Project scheduling using Gantt charts & PERT, Capability Maturity Model (CMM), ISO 9000, Personal Software Process (PSP), Six Sigma, CASE: Scope, Environment & Support in Software life cycle, Software maintenance, Software reuse oriented model		
Text Books:		
1. Software Engineering by K. K. Aggarwal &Yogesh Singh, New Age International, 3rd Edition, 2008. 2. Fundamentals of Software Engineering by Rajib Mall, PHI, 4th Edition, 2014.		
Reference Books:		
1. Software Engineering: A Practioner's Approach by Roger S. Pressman, McGraw Hill, 7th Edition, 2010.		

Formal Language and Automata Theory					
COURSE OUTLINE					
Course Title:	**Formal Language and Automata Theory**	**Short Title:**	**FLAT**	**Course Code:**	

Course description:

The objective of this course is to introduce the students the knowledge of automata theory, Principles of Grammars, Push down Automata, Turing Machines and enable them to apply these concepts for solving computational problem.

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

Prerequisite course(s):

Knowledge of Discrete Structure & Graph Theory and Data Structures.

Course objectives:

1. Understand the concept of finite automaton as a regular language recognizer.
2. Understand the concept of regular expression as a description of a regular language.
3. Understand the concept of formal grammar and their types, as well as the type of language.
4. Understand the concept of a pushdown automata to recognize any context-free language
5. Understand the principles and operation of a Turing Machine and its different types.

Course outcomes:

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

1. Understand the basic of formal languages and automata theory.
2. Describe and transform regular expression for computation.
3. Construct/convert grammars for formal languages.
4. Interpret PDA for Context free language and regular language.
5. Design and analyze the Turing machine for formal languages.

COURSE CONTENT

Formal Language and Automata Theory		Semester:	V
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

Finite State Machines:

Mathematical Preliminaries: Sets , Relations and Functions, Alphabets, Words / Strings, their Properties and operations, Graphs and trees,

Finite State Machines: State tables, Transition graph, Adjacency matrix, Description of a Finite automaton, Transition Systems, Properties of Transition functions, Acceptability of a string by a FA, Deterministic and Non-deterministic FSM's, Equivalence of DFA and NFA, Moore and Mealy Models, Minimization of Finite Automata, FSM with Epsilon moves

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

Regular Expressions:
Definition, Identities for Regular Expressions, Finite Automata and Regular Expressions Transition System Containing Epsilon-moves, NDFAs with Epsilon-moves and Regular, Expressions, Conversion of Nondeterministic Systems to Deterministic Systems, Building RE, Construction of Finite Automata Equivalent to a Regular Expression, Conversion of RE to FA, Converting FA to RE, Equivalence of two FA, Pumping lemma for regular sets, Applications of Pumping lemma, Closure properties of Regular sets

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

Grammars:
Definition, Derivation trees, Leftmost and Rightmost Derivations, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Construction of Reduced Grammar, Eliminating Useless symbols, Eliminating Epsilon productions, Eliminating Unit productions,
Normal Forms for Context – free Grammars, Chomsky Normal Form, Greibach Normal Form, Reduced Forms – CNF and GNF, Reduction to CNF and GNF, Pumping Lemma for Context – free Languages, Decision Algorithms for Context- free Languages

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

Pushdown Stack Memory Machines & Production Systems:
Pushdown Stack Memory Machines: Definition, PDM examples, Acceptance by PDA
Power of PDM, Deterministic and Non-deterministic PDM, Construction of PDA from CFG, Construction of CFG from PDA
Production Systems: Definition, Post canonical system, PMT systems, Markov algorithm

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

Turing Machine:
Turing Machine Model, Representation of Turing Machines, Design of Turing Machines, Techniques for TM Construction, Variants of Turing Machines, Composite and Iterated TM, Universal TM, TM limitations, The Halting problem

Text Books:

1. K.L.P.Mishra, N. Chandrasekaran, "Theory of Computer Science Automaton, Languages and Computation", Third Edition, PHI.
2. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson.
3. An Introduction to Formal Languages and Automata, by Peter Linz, Third Edition, Narosa Publishers (1998)
4. E V Krishnamurthy, S.K.Sen, "Introductory Theory of Computer Science", Second Edition, EWP.

Reference Books:

1. Daniel Cohen, "Introduction to computer Theory", Wiley India.
2. John Martin, "Introduction to Languages and the Theory of Computation", TMH.
3. Lewis H., Papadimitriou C., "Elements of Theory of Computation", Second Edition, Pearson.
4. Moret B., "The Theory of Computation", Pearson Education.

Artificial Intelligence (Professional Elective Course – I)					
COURSE OUTLINE					
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):

NA

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 CONTENT

Artificial Intelligence		Semester:	V
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 Techniques		
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.		

Advanced Computer Architecture (Professional Elective Course – I)					
COURSE OUTLINE					
Course Title:	**Advanced Computer Architecture**	**Short Title:**	**ACA**	**Course Code:**	
Course description:					
The aim of this course is to introduce the students to the fundamentals of parallel processing along with various parallel computer structures, pipelining, array processor, and multiprocessor architecture.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Fundamental knowledge of Microprocessor, Computer Organization, Operating Systems					
Course objectives:					
1. To learn the concept of Parallel computer structures. 2. To study Principles of pipelining. 3. To gain knowledge of Structures and algorithms for array processors 4. To understand the interconnection network in parallel architecture. 5. To understand Multithreading and principles of it.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Explain parallelism concept in uniprocessor as well as parallel computer structures. 2. Identify the principles of pipelining along with design of instruction and arithmetic pipeline. 3. Apply parallel algorithms for array processor. 4. Enumerate and analyze various SIMD interconnection Networks. 5. Discuss multithreading with the various issues and solutions					
COURSE CONTENT					
Advanced Computer Architecture			**Semester:**	**V**	
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 Parallel Processing:- Evolution of computer systems, Parallelism in Uniprocessor Systems, Parallel Computer Structure, Architectural Classification Schemes, Clock rate and CPI, Performance Factors, System Attributes, MIPS Rate, Throughput Rate, Implicit Parallelism, Explicit Parallelism, Parallel Processing Applications. Program and Network Properties:- Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures					
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**		
Processor and Memory Hierarchy:- Design Space of Processors, Instruction Set Architectures, CISC Scalar Processors, RISC Scalar Processors, Super Scalar and Vector Processors.					

Memory Hierarchy Technology:- Hierarchical Memory Technology, Inclusion, Coherence and Locality, Memory Capacity Planning.
Shared Memory Organization: Interleaved Memory Organization, Bandwidth and Fault Tolerance, Memory Allocation Schemes.
Principles of Pipelining: Principles of Linear pipelining, Classification of Pipeline Processor, General Pipelines and Reservation Tables.

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

Pipelining and Superscalar Techniques:- Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design
Introduction to Hazards: - WAR, RAW, and WAW hazards.
Array Processors:- SIMD Array Processors: SIMD Computer Organizations, Masking and Data Routing Mechanisms, Inter-PE Communications.
SIMD Interconnection Networks:- Static versus Dynamic Networks, Mesh-Connected Illiac Network, Cube Interconnection Networks, Barrel Shifter and Data Manipulator, Shuffle-Exchange and Omega Networks.

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

Parallel Algorithms for Array Processors:- SIMD Matrix Multiplication, Parallel sorting on Array Processor,
Multiprocessor Architectures: Loosely Coupled Multiprocessors, Tightly Coupled Multiprocessors, Processor Characteristics for Multiprocessing,
Parallel Algorithms for Multiprocessors:- Classification of Parallel Algorithms, Synchronized and Asynchronized Parallel Algorithms.
Vector Processing Principles: Characteristics of Vector Processing, Vector Instruction Types, Vector-Access Memory Schemes, characteristics of vector processing.

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

Principles of Multithreading:- Issues and Solution, Multiple-Context processor, Multidimensional Architectures.
Parallel Programming Models:- Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models.
Parallel Languages:- Language Features for Parallelism, Parallel Language Constructs.
Data Flow Computers:- Control-Flow versus Data Flow Computers.

Text Books:

1. Kai Hwang and Faye A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill International Editions.
2. Kai Hwang, Advanced Computer Architecture, Parallelism, Scalability, Programmability, Tata McGraw-Hill Edition.

Reference Books:

1. Michael J. Quinn, Parallel Computing, Theory and Practice, Tata McGraw-Hill Edition, Second Edition.
2. V. Rajaraman and C. Siva Ram Murthy, Parallel Computers, Architecture and Programming, PHI.

3. Sajjan G. Shiva, Advanced Computer Architectures, CRC Taylor and Francis Special Indian Edition.
4. Rajiv Chopra, Advanced Computer Architecture (A Practical Approach), S. Chand, Revised Edition.

Computer Graphics (Professional Elective Course – I)

COURSE OUTLINE

Course Title:	**Computer Graphics**	**Short Title:**	**CG**	**Course Code:**	

Course description:

Computer Graphics is a study of the hardware and software principles of interactive raster graphics. Topics include an introduction to the basic concepts, 2-D and 3-D modeling and transformations, viewing transformations, projections, rendering techniques, graphical software packages and graphics systems.

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

Prerequisite course(s):

Basic knowledge of C,C++ Programming

Course objectives:

1. To learn the fundamental concept of computer graphics
2. To understand the concepts line and circle generation.
3. To understand the concepts of polygon, polygon filling, polygon clipping.
4. Tolearn concept of transformation for animation and simulation.
5. To learn the concept of projection for drawing of various objects.

Course outcomes:

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

1. Remember line and circle drawing algorithm for drawing various objects.
2. Apply various polygons filling algorithm to fill the object.
3. Use of geometric transformations on graphics objects and their application in composite form
4. Apply the concept of projection to draw the object.
5. Analyze projected objects to naturalize the scene in 2D view and use of illumination models for the same.

COURSE CONTENT

Computer Graphics		**Semester:**	**V**
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: 8 Hours**	**Marks: 12**

A Survey of Computer: Computer-Aided Design, Presentation Graphics, Computer Art, Entertainment Education and Training, Visualization, Image Processing, Graphical User Interfaces, Points and Lines: Line-Drawing Algorithms, DDA Algorithm, Bresenham's Line Algorithm, Parallel Line Algorithms, Loading the Frame Buffer, Line Function, Circle-Generating Algorithms, Properties of Circles, Midpoint Circle Algorithm.

Unit–II:	No. of Lectures: 9 Hours	Marks: 12
Output Primitives: Filled-Area Primitives: Scan-Line, Polygon Fill Algorithm, Inside-Outside Tests, Scan-Line Fill of Curved Boundary Areas, Boundary-Fill Algorithm, Flood-Fill Algorithm, Fill-Area Functions, Cell Array, Character Generation, Segments.		
Unit–III:	**No. of Lectures: 8 Hours**	**Marks: 12**
Two-Dimensional Geometric Transformations: Translation, Rotation, Scaling, Matrix Representations, and Homogeneous Coordinates .Composite Transformations, Translations, Rotations, Scaling. General Pivot-Point Rotation, General Fixed-Point Scaling, General Scaling Directions, Concatenation Properties.		
Unit–IV:	**No. of Lectures: 9 Hours**	**Marks: 12**
Two-Dimensional Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window to viewport Coordinate Transformation. Two-Dimensional viewing Functions. Clipping Operations: Point Clipping, Line Clipping, Cohen-Sutherland Line Clipping, Polygon Clipping, Sutherland-Hodgernan Polygon Clipping.		
Unit–V:	**No. of Lectures: 8 Hours**	**Marks: 12**
Visible Surface Detection Methods: Classification of Visible-Surface Detection Algorithms. Back-Face Detection, Depth-Buffer Method, Light Sources, Basic illuminations Models, Ambient Light, Diffuse Reflection Specular Reflection, and the Phong Model, Combined Diffuse and Specular reflections with multiple light sources.		
Text Books:		
1. Donald Hearn and Pauline Baker," Computer Graphics", Pearson LPE, Second edition.		
Reference Books:		
1. David F. Rogers, "Procedural Elements for Computer Graphics, Tata McGraw Hill, Second edition. 2. Steven Harringtom, "Computer graphics A Programming Approach", MGH. 3. Maurya, "Computer Graphics: with virtual reality system", Wiley India. 4. Foley, Vandam, Feiner, Hughes, "Computer Graphics Principals & Practice", Pearson, Second edition. 5. Rao and Prasad," Graphics user interface with X windows and MOTIF", New Age.		

Information Theory and Coding (Professional Elective Course – I)

COURSE OUTLINE

Course Title:	**Information Theory and Coding**	**Short Title:**	**ITC**	**Course Code:**	

Course description:

Information theory provides mathematical modeling for the different aspect of Communication System. Primary goals to be provide encoding and decoding scheme for a given combination of channel model.

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

Prerequisite course(s):

Probability, Mathematical methods for Computer Science, Discrete Mathematics

Course objectives:

1. To understand fundamental knowledge of Entropy, Discrete Memoryless Source, And Block Coding.
2. To learn Different Variable Length Source Coding techniques.
3. To understand Mutual Information, Discrete Memoryless Channel and Channel Capacity.
4. To learn Channel theorems.
5. To learn Linear Error Correcting Codes for the binary Symmetric Channel.

Course outcomes:

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

1. Demonstrate fundamental knowledge of Entropy, Discrete Memoryless Source and Block Coding.
2. Apply Variable length Source Coding
3. Calculate Channel Capacity.
4. Apply Channel Theorems.
5. Apply Coding Techniques.

COURSE CONTENT

Information Theory and Coding		**Semester:**	**V**
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**

Entropy, Discrete Memoryless Source, and block Encoding :Entropy of a Discrete Random variable, H(X) as a Measure of Uncertainty, Entropy and Sequences of a Random Variable, Discrete Memoryless Source and Likely Sequences, Block Encoder with Fixed-length Alphabet, Block Encoder with variable-length Alphabet.

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

Variable-Length Source Coding: Unique Decodability and Prefix Condition, Kraft Inequality,

Significance of the Prefix Condition, Shannon-Fano Coding, Optimum Binary Coding: Huffman's Technique, Geometrical Interpretation of Huffman's Technique, Generalization of Huffman's Technique.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Mutual Information, Discrete Memoryless Channel, and Channel Capacity: Conditional Entropy and Mutual information, Discrete memoryless Channel and Channel Matrix, Symmetric, Lossless, Deterministic, and Useless Channels Equivocation and the rate of Transfer of Information, Channel Capacity		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Channel Theorems: Conditional Mutual information and Capacity, Cascaded Channels, Reduced Channels and Sufficient Reductions, Fano's Bound on Equivocation, Improving Channel Reliability, Noisy Channel Theorem for the BSC, Noisy Channel theorem for the General DMC, Converse Theorem.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Linear Error-Correcting Codes for the Binary Symmetric Channel: Hamming Distance and Error-Correcting Power, Hamming Upper Bound on the number of Code Words, Parity Check Codes, Properties of the Parity Check Matrix, Construction of Parity Check Codes from the Matrix, Equivalence of Group Codes and parity Check Codes, Decoding of Parity Check Codes: Decoding Sets, Error-Correcting power of Parity Check Codes, Hamming Lower Bound on the number of Check Digits, Varsharmov-Gilbert Upper bound on the Number of Check Digits, Convolutional Encoder, State and Ladder Diagrams, Maximum Likelihood Decoding and the Viterbi Algorithm.		
Text Books:		
1. M. Mansurpur, Introduction to Information Theory, Prentice-Hall, 1987.		
Reference Books:		
1. N. Abramson, Information and Coding, McGraw Hill, 1963. 2. R.B. Ash, Information Theory, Prentice Hall, 1970. 3. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.		

Operations Research (Open Elective Course – I)

COURSE OUTLINE

Course Title:	**Operations Research**	**Short Title:**	**OR**	**Course Code:**	

Course description:

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 modeling 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.

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

Prerequisite course(s):

Familiarity with linear algebra is required.

Course objectives:

Students to use quantities methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course outcomes:

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

1. Describe the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
2. Choose the alternative that best meets the objectives.
3. Use methods of the graph in solving linear program and to find the optimal solution.
4. Build and solve Transportation Models and Assignment Models.
5. Identify and develop operational research models from the verbal description of the real system.

COURSE CONTENT

Operations Research		**Semester:**	**V**
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**

Operation Research – An Introductions

The history of OR, Definition, Features, of OR, models and modeling 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. .

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Linear Programming- Introduction, general Stricture of LP model, Assumption of an LP model, Advantages and Limitations of Linear programming, Applications areas of LP, steps 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: 09 Hours**	**Marks: 12**
Transportation problem introduction, mathematical model of transportation problem, Algorithm, methods for finding initial solution northwest corner method ,Least cost method, vogels 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. Manohar Mahajan, “Operation Research” , Dhanpat Rai Publication , Delhi		
Reference Books:		

1. Taha ,"Operation Research" , PEARSON Publication
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 modeling and applications"

Renewable Energy Sources (Open Elective Course – I)					
COURSE OUTLINE					
Course Title:	**Renewable Energy Sources**	**Short Title:**	**RES**	**Course Code:**	
Course description:					
This course includes the fundamental knowledge and various methods as well as technologies involved in utilization of various types of renewable energy sources.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Physics, chemistry, thermodynamics, power electronics					
Course objectives:					
At the end of the course, the students are expected to study and identify the new methodologies / technologies for effective utilization of renewable energy sources.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Tell about worldwide scenario about renewable energy status. 2. Discuss about various solar thermal collectors and fundamentals of solar cell. 3. Illustrate and justify wind and geothermal system. 4. Assess and classify the use of biomass and biogas energy system. 5. Study and evaluate the performance of different types of turbines used in tidal system.					
COURSE CONTENT					
Renewable Energy Sources			**Semester:**	**V**	
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: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. **Energy from Sun:** Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications					
Unit–II:	**No. of Lectures: 08 Hours**		**Marks: 12**		
Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space					

Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems, Photovoltaic System

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

Wind Energy: Fundamentals of Wind Technology Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects

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

Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics.

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

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power.

Text Books:

1. Rai. G.D., “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.
3. Sukhatme. S.P., “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

Reference Books:

1. Godfrey Boyle, “Renewable Energy, Power For A Sustainable Future”, Oxford University Press, U.K., 1996.
2. Tiwari. G.N., Solar Energy – “Fundamentals Design, Modelling& Applications”, Narosa Publishing House, New Delhi, 2002.
3. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.

Cyber Law and Ethics (Open Elective Course – I)					
COURSE OUTLINE					
Course Title:	**Cyber Law and Ethics**	**Short Title:**	**CLE**	**Course Code:**	

Course description:

This course introduces basics of cyber laws and computer ethics encompassing user behavior and what computers are programmed to do, and how this affects individuals and society. Emphasis is given on the ethical issues that arise as a result of increasing use of computers and the responsibilities of people who work with computers and provides new dimension to look towards their day to day computer activities.

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

Prerequisite course(s):

Course objectives:

1. Describe need for cyber laws.
2. Identify objectives and scope of IT act.
3. Understand the concept of e-commerce issues.
4. Understand ethical issues.
5. Understand and dissect information system and security.

Course outcomes:

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

1. Describe fundamentals of cyber laws, its scope and intellectual property issues.
2. Analyze and identify patent and copyright issues.
3. Apply issues in e-commerce security issues.
4. Illustrate ethical issues in data and software privacy.
5. Summarize the importance of information security.

COURSE CONTENT

Cyber Law and Ethics		**Semester:**	**V**
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**

History of Internet, Introduction to Indian Cyber Law, Need for Cyber Laws, Jurisprudence of Cyber Law, Objective and Scope of the IT act 2000, Uncitral Model Law, ISP Guideline, Intellectual Property Issues, Overview of Intellectual Property Related Legislation in India, Rationale behind Intellectual Property, Underlying Premises of IP, Balancing the Rights of the Owner of IP and the Society, Enforcement of IRPS, IP and Constitution of India

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

Patent: The Patent System, Patentable Invention, Non patentable Procedure for Obtaining

Patent, Copyright, Trademark Law, Law related to Semiconductor Layout and Design E-Commerce in India, Scope of E-Commerce in India, E-Commerce and the Government of India, Specifying Guidelines to Enter E-Marketplace, E-Agreement, Legal Recognition of Electronic and Digital Records, Legal Recognition of Digital Signatures		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
E-Commerce Issues of Privacy, Security Threats to E-Commerce **Physical Security:** Incidents of Physical Security Violations, Disaster and Controls, Basic Tenets of Physical Security, Challenges in Ensuring Physical Security, Physical Entry Controls, Steps to Perform after Physical Security Breach		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Cybercrime, Cyber/Resource Theft, Types of Cyber Crimes/Frauds, Cyber Frauds in India, Cyber Jurisdiction, Dealing with Cybercrime in Various Countries **Ethical Issues in Data and Software Privacy:** Plagiarism, Pornography, Tampering Computer Documents/System Hacking, Data Privacy and Protection, Software Privacy, Social Engineering and Fishing, Types of Social Engineering, Exploring Methods of Phishing, Issues in Ethical Hacking, Cyber Crime Forensic		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Information Systems, IS Components, Trends in IS, Classification of IS, Framework of IS in an Organization, IS and Business Organization, Human Body as an Information System, IS Failures and Causes, Role of Security in Internet and Web Services, Securing Web Services, Principles of Information Security, An Overview of Information Security Management System(ISMS), Benefits of ISMS, Classification of Threats and Attacks, Information Classification and their Roles, Roles and Responsibilities of Information Authority		
Text Book:		
Faiyaz Ahamad, “Cyber Law and Information Security”, Dreamtech Press		
Reference Books:		
1. Sanjeev Kumar Sharma , Ankur Shree Aggarwal and AnuradhaTyagi, “Information Security and Cyber Laws” 2. Pavan Duggal, “Cyber Security Law”		

E – waste management (Open Elective Course – I)					
COURSE OUTLINE					
Course Title:	**E – waste management**	**Short Title:**	**EWM**	**Course Code:**	

Course description:

The present era is truly an electronics and IT era. Electronic devices have become an integral part of each and every aspect of day to day modern life. Ultimately, every electronic gadget one day becomes a waste. Its huge quantity and hazardous nature becomes a great concern to the environmentalists. This paper is aimed to create awareness in the mind of students about the gigantic issue of e waste and prevailing legislations about it. It appraises the students about its bad effects on environment and human health and to train the student in disposal methodologies in this regard.

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

Prerequisite course(s):

-

Course objectives:

1. To appraise and aware the student about problem of e – waste.
2. To appraise and aware and student about environmental legislations pertaining to solid waste.
3. To train a student in designing a complete e – waste management plan of a locality or industrial sector including collection, recovery, recycling and disposal of solid waste in an environmentally consistent manner.

Course outcomes:

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

1. Evaluate the rate of generation of e waste from a particular sector
2. Analyze the e waste generated by a sector.
3. Understand the detrimental effects of solid waste.
4. Design a comprehensive plan to collect, recycle and dispose off e waste generated by a sector.
5. Evaluate the economics and man power requirements of the e waste management plan.

COURSE CONTENT

E – waste management		Semester:	V
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

History of solid waste problem, solid waste management in ancient India and modern India, black death incidence of Europe, aspects of global solid waste problem.

Types of solid waste, *E* waste: Sources, generation rates and global generation scenario.

Hazardous Waste (Management and Handling) Rules, 1989 and amendments, Federal Hazardous Waste Regulations under RCRA, Superfund, CERCLA and SARA. Toxicology, public health

impact, and Protocols in *E* waste management.

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

Assessment of *E* waste generation rates, sampling plans and protocols, characterization of *E* waste, constituents of *E* waste, parameters of concern in *E* waste, measurement of toxicity of *E* waste.
Various aspects Pollution effects of *E* waste. Occupational and environmental health perspectives of *E* wastes.
Objectives and scope of *E* waste management. *E* waste material flow. Components of *E* waste management. Stake holders in *E* waste management.

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

Mechanisms of *E* waste trade. *E* waste life cycle. Fate of constituents of *E* waste in environment.
Current *E* waste management practices, Institutional mechanism, collection system for *E* waste, logistics for *E* waste. Economic aspects specially pertaining to developing countries. G – 8 3R initiative. Global *E* waste sustainability initiative.
Strategies for *E* waste management, collection systems, collection channels, collection infrastructures, principles of designing collection system for *E* waste.

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

E waste treatment technologies, first level treatment, second level treatment, third level treatment technology. Environmental impacts of first, second and third level of treatment.
Assessment of man power for *E* waste management of a locality.
Financial aspect of E waste collection, handling, treatment and recycling. Financial models proposed for developing countries.

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

E waste management Innovation hubs and knowledge centre's of excellence in emerging economies: case study of India, China and South Africa.
E waste management Innovation hubs and knowledge centre's of excellence in developed countries: case study of USA.
Risk profiling in *E* waste management. Workers' safety and legislations.

Text Books:

1. E-waste Volume II: E-waste Management Manual by United Nations Environmental Programme, Division of Technology, Industry and Economics, International Environmental Technology Centre, Osaka/Shiga.
2. RECYCLING FROM E-WASTE TO RESOURCES Guido Sonnemann, UNEP DTIE Bas de Leeuw, UNEP DTIE, Printing Oktoberdruck AG, Berlin, Germany.

Reference Books:

1. Electronic Waste: Recycling Techniques. Edited by Hugo Marcelo Veit and Andrea MouraBernardes, Springer publication.
2. E waste management: from waste to resource. Edited by Klaus Hieronymi, RamzyKahhat, and Eric Williams.Published by Taylors and Francis.

Database Management Systems Lab

LAB COURSE OUTLINE

Course Title:	**Database Management Systems Lab**	**Short Title:**	**DBMSL**	**Course Code:**	

Course description:

Students will learn and practice Structure Query Language for creation, Manipulation, controlling database, apply normalization techniques to normalize the database, different types of Join, view, PL/SQL, Trigger, Stored Procedure, Stored function and enable them to apply these concepts for solving real world problems

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. To understand and use Data Definition Language to define and modify database schema
2. To understand and use Data manipulation language to query, update, and manage a database
3. To demonstrate competence with the fundamental tasks involved with implementing a DBMS.

Course outcomes:

Upon successful completion of lab Course students will be able to

1. Develop a database with various constraints using SQL Data Definition Language.
2. Use DML queries to retrieve, insert, delete and update the database.
3. Apply various SQL features such as Aggregate functions, Set Operations and Views to resolve the queries.
4. Demonstrate Stored Procedure, Stored function and Trigger on a Sample Databases.
5. Develop database application using ODBC/JDBC interface to store and retrieve data from the database.

LAB COURSE CONTENT

Database Management System Lab		**Semester:**	**V**
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 ALL Laboratory assignments from Group - A and THREE Laboratory assignments from Group – B from the following list.

GROUP A

1**.** Creating a sample database using any client server RDBMS package using SQL DDL queries. This will include constraints (Primary key, Foreign key, Unique, Not Null, and Check) to be used

while creating tables.
2. SQL DML queries: Use of SQL DML queries to retrieve, insert, update and delete the database.
3. SQL Queries: The queries should involve SQL feature such as aggregate functions, group by, having, order by clause.
4. SQL Queries: The queries should involve Set Operations and Set Comparisons on the database
5. Develop two tier architecture and use ODBC/JDBC connections to store and retrieve data from the database. You may consider any applications like employee management system, library management system etc.

GROUP B

1. Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view.
2. Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table.
3. Write a program to demonstrate PL/SQL block
4. Write a program to demonstrate PL/SQL stored procedure.
5. Write a program to demonstrate different types of Join.
6. Write a program to demonstrate PL/SQL stored function

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill.
2. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.

Reference Books:

1. Rick F. Van der Lans, "Introduction to SQL", Pearson education.
2. B. Rosenzweig, E. Silvestrova, "Oracle PL/SQL by Example", Pearson education.
3. Steven Feuerstein, "Oracle PL/SQL Programming", SPD, O'Reilly.
4. Dr. P. S. Deshpande, "SQL& PL/SQL for Oracle 10g Black Book", Dreamtech Press
5. M. McLaughlin, "Oracle Database 11g PL/SQL Programming", TMH.
6. J. J. Patrick, "SQL Fundamentals", Pearson Education.

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 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.

Software Engineering Lab

LAB COURSE OUTLINE

Course Title:	**Software Engineering Lab**	**Short Title:**	**SEL**	**Course Code:**	

Course description:

The laboratory provides students an ability to apply software engineering analysis & design concepts for developing quality software, economically.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

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

Prerequisite course(s):

Knowledge of object oriented concepts and any system programming language.

Course objectives:

1. Students will understand an open source CASE tool software development environment.
2. Students will learn Unified Modeling Language and types of UML diagrams.
3. Students will think of UML diagrams to analyze, develop and deploy object-oriented software systems.

Course outcomes:

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

1. Analyze the type of UML diagram s required for proposed software system
2. Decide contents of the UML diagrams
3. Design basic and advanced structural UML modeling diagrams
4. Design basic and advanced behavioral UML modeling diagrams
5. Develop various UML Models for proposed software.

LAB COURSE CONTENT

Software Engineering Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End Semester Exam (ESE):(OR)**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

The Software Engineering Laboratory assignments must include any FOUR of following software mini-projects covering Problem Definition, Analysis & Design using CASE tool and the documentation for each.

1) Automated Teller Machine System
2) Library Management System
3) Railway Reservation System
4) Hospital Management System
5) Vehicle Navigation System
6) Hotel Management System
7) College Admission System

8) Inventory Control System **Note: -** Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.
Text Books:
1. UML 2.0 In A Nutshell - A Desktop Quick Reference by Dan Pilone with Neil Pitman, O'Reilly SPD, First Edition, 2005.
Reference Books:
1. Object Oriented Software Engineering – A practical Software Development using UML and Java by Timonthy C. Lethbridge and Robert Laganiere, 2nd Edition, McGraw Hill.
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 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.

Web Programming Language Lab

COURSE OUTLINE

Course Title:	**Web Programming Language Lab**	**Short Title:**	**WPL**	**Course Code:**	

Course description:

This course introduce the students to fundamentals of web programming languages like HTML, JavaScript, PHP and enable them to apply these concepts for web page development. Course also introduces the concept of connecting database to web page with MySQL.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern	**Practical (PR)**

Prerequisite course(s):

Basics of web programming.

Course objectives:

1. To learn the concepts of basic web programming.
2. To understand the concepts of HTML with CSS tags to help web page design.
3. To understand the basic concepts JavaScript and PHP.
4. To know database connectivity to web page using MYSQL and JDBC/ODBC.
5. Learn web server installation and configuration.

Course outcomes:

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

1. Apply suitable web scripting for a various applications.
2. Use of web scripting to create and develop a web page.
3. Use of control structure, loops and array in JavaScript.
4. Apply knowledge to design a web page using PHP to demonstrate MySQL connectivity.
5. Demonstrate date, file, cookies and sessions using PHP.

COURSE CONTENT

Web Programming Language Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:02 Hrs	**hours/week :02 Hrs**	**End semester exam (ESE): (PR)**	**25**
		Internal Continuous Assessment (ICA):	**25**

Concerned faculty member should suitably frame SIX Laboratory assignments from Group - A and FOUR Laboratory assignments from Group – B from the following list.

GROUP A

1. **Develop a complete web page using HTML basic tags ,**
   - A simple web page that includes basic tags such as head, body, text formatting tags, lists, paragraph, table, image tags,

2. **Develop A web page using CSS, and Layout** ,
   -A layout includes Header, Footer ,Navigation, Article, etc
3. **Design a web page using JavaScript to demonstrate, if statement, if...else statement and Switch statement**
   -A simple web page that include JavaScript statements such as if, if...else and switch.
4. **Design a web page using JavaScript to demonstrate, Alert box, Alert box with line breaks Confirm box and Prompt box**
   -A simple web page that include JavaScript alert box, alert box with line breaks, confirm box and prompt box.
5. **Design a web page using JavaScript to demonstrate, call a function , function with an argument , Function that returns a value**
   - A simple web page that include JavaScript call a function, function with arguments, function that return a value.
6. **Design a web page using JavaScript to demonstrate use of loops.**
   - A simple web page that include JavaScript for loop, while loop , do while loop, break a loop, break and continue a loop.
7. **Design a web page using JavaScript to demonstrate, Sort an array.**
   (A simple web page that include JavaScript to sort an array alphabetically and ascending, sort numbers numerically and ascending and sort numbers numerically and descending.

GROUP B

1. **Design a web page using PHP to demonstrate, variables, echo/print, data types, string functions and operators.**
   -A simple web page that include PHP variables, echo/print, data types, string functions and operators.
2. **Design a web page using PHP to demonstrate conditional statement and loops,**
   -A simple web page that include PHP if if –else, else_if, switch, for loop, while loop,
3. **Web server installation and configuration**
   - Installation and configuration of any web server like IIS, Apache, WAMP, XAMP, LAMP etc.
4. **Design a web page using PHP to demonstrate, date, file, cookies and sessions.**
   -A simple web page that include PHP date, file, cookies and sessions.
5. **Design a web page using PHP to demonstrate MySQL connectivity.**
   -A simple web page that include PHP MySQL connect, create DB/Table, insert into, select, update and delete.
6. **Design a Website with the help of HTML and JavaScript/PHP (Commercial, Institute, Portal or decided jointly by the student and teacher).**
   -Design a website on the above listed topics with the help of HTML and JavaScript/PHP.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. "Web Technologies HTML, JavaScript, PHP, Java JSP, XML and AJAX", BLACK BOOK NEW, KOGENT Learning Solutions Inc., dreamtech PRESS, Edition (2013)

2. Jon Duckett, " Beginning HTML, XHTM, CSS, and JavaScript",John Wiley & Sons Publications, Edition (2014).
3. Deitel&Deitel, "Internet and World Wide Web How to Program", Pearson education, 3rd Edition.

Reference Books:

1. Ivan BayRoss, "Web Enabled Commercial Application using Java 2", bpb publication, 4thEdition.
2. David Flanagan, Java Script The Definitive Guide, O"relly, 5e (2006) Publications, 6th 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 understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Minor Project (Stage – I)

LAB COURSE OUTLINE

Course Title:	**Minor Project (Stage – I)**	**Short Title:**	**MPROJ-SI**	**Course Code:**	

Course description:

Minor project represent the culmination of study towards the Bachelor of Engineering degree. The minor 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**
	6	**14**	**84**	**3**

End Semester Exam (ESE) Pattern: **----**

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

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

At third year the students shall carry out a minor project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – V the students shall complete the partial work, and by the end of Semester – VI 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 minor 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 – IV. 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.

Minor 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 – V. Each student group should submit partial project report in the form of thermal bound at the end of Semester –V.

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

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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 Minor Project (stage – I) in Semester – V 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

Constitution of India

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

KavayitriBahinabaiChaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Third Year Engineering
(Computer Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

COURSE OUTLINE
Semester - VI
W.E.F. 2020 – 21

OPERATING SYSTEMS					
COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS**	**Short Title:**	**OS**	**Course Code:**	

Course description:

This course is to introduce the concept of Operating System, process management, memory management, file management & disk management.

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

Prerequisite course(s):

Computer Organization, System Programming

Course objectives:

1. To understand the concept of OS, Process and Threads.
2. To know the mechanism of Process Scheduling and Inter Process Communication.
3. To understand deadlock conditions and memory management concept.
4. To gain knowledge about Virtual memory and File management in OS.
5. To know Input Output System along with Mass storage Structure.

Course outcomes:

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

1. Explain concept of OS, Process and Thread.
2. Solve the problems on Process Scheduling and IPC.
3. Decide Deadlock conditions and memory management concept.
4. Describe mechanism of Virtual memory and File management in OS.
5. Select IO system and Mass storage structure.

COURSE CONTENT

OPERATING SYSTEMS		Semester:	VI
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:

What is Operating Systems, Types of Operating System, Functions of Operating System, Operating-System Services, Structure of an OS – Layered, Monolithic, Microkernel OS, System Calls.

Process:

Process Concept, Different states of a Process, Process states transitions, Process Control Block, Context Switching

Thread: Definition, Various states, Benefits of threads, Types of threads

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

Process Scheduling: Scheduling, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time

Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR, Priority based Scheduling

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Peterson's Solutions, The Producer Consumer Problem, Semaphores, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. **Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging, Segmentation		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Virtual Memory: Background, Demand paging, Page Replacement, Page Replacement algorithm: First in First Out (FIFO), Optimal, Least Recently used (LRU), Thrashing **File Management**: File concept: File Attributes, File operation, File types, File structure. Access methods, Directory structure, File system mounting, Allocation methods (contiguous, linked, indexed)		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
I/O System: I/O Hardware, Interrupts, Direct memory access **Mass storage structure:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK. Disk Management, Swap Space Management, RAID Structure.		
Text Book:		
1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.		
Reference Books:		
1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India. 2. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing 3. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley		

Computer Networks					
COURSE OUTLINE					
Course Title:	**Computer Networks**	**Short Title:**	**CN**	**Course Code:**	

Course description:

The Internet has become one of the most important components of our life. We browse the Web, check e-mails, make VoIP phone calls, and have video conferences via computers. All of these applications are made possible by networking computers together, and this complex network of computers is usually referred to as the Internet. This course is designed to give you a clear understanding of how networks, from in-home local area networks, or LANS, to the massive and global Internet, are built and how they allow us to use computers to share information and communicate with one another.

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

Prerequisite course(s):

Introduction to Computer Systems, Data Structures and Algorithms, and Program Design or a program or courses of similar content.

Course objectives:

1. To study general principles of data communication.
2. To study OSI reference model and the TCP-IP reference model.
3. To study IP Layer.
4. To study transport layer.
5. To study cryptography and network security.
6. To study wireless networking concepts.

Course outcomes:

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

1. Explain the basics concepts of data communication and networking.
2. Solve numerical of IP addressing and describe internet protocol along with address mapping.
3. Describe error reporting and forwarding along with routing protocols.
4. Demonstrate process to process communication at transport layer using TCP and UDP.
5. Discuss network security and wireless networking concepts.

COURSE CONTENT

Computer Networks		Semester:	VI
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	

Data Communications: Components, Types of Data Flow, Networks, Topologies, Categories
Network Models: Layered Task, The OSI Model, TCP/TP Protocol Suite
Addressing: Physical Addresses, Logical Addresses, Port Addresses, And Specific Addresses.
Data Link Layer: Framing, Flow and Error Control
Wired LANs Ethernet: IEEE Standards, Standard Ethernet, 802.3 MAC Frame Format Changes in the standard Ethernet

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

Logical Addressing: IPv4 Addresses: Address Space, Notations, Classful Addressing, Classless Addressing, Network Address Translation (NAT).
Internet Protocol: IPv4: Datagram, Fragmentation, Checksum, Options. IPv6: Structure, Address Space, Advantages, Packet Format, Extension Headers, Transition from IPv4 to IPv6: Dual Stack, Tunneling, Header Translation.
Address Mapping: Mapping Logical to Physical Address: ARP, Mapping Physical to Logical Address: RARP, BOOTP and DHCP.

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

Error Reporting: ICMP: Types of Messages, Message Format, Error Reporting Messages, Query Massages, Ping and Traceroute Debugging Tools.
Delivery: Direct Versus Indirect Delivery.
Forwarding: Forwarding Techniques, Routing Table.
Unicast Routing Protocols: Intra and Interdomain Routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP

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

Transport Layer: Transport-layer services: Process-to-Process Communication,
Addressing: Port Numbers, Encapsulation and Decapsulation, Multiplexing and Demultiplexing, Flow Control and Error Control.
User Datagram Protocol (UDP): User Datagram, UDP Operation, Uses of UDP
Transmission Control Protocol (TCP): TCP Services, TCP Features, TCP Segment, TCP Connection, Flow Control, Error Control and Congestion Control: open-loop congestion control and closed-loop congestion control techniques.

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

Application Layer: Introduction to DNS, SMTP, POP, FTP, HTTP Protocols
Network Security: Introduction to cryptography, symmetric-key and asymmetric key Cryptography, XOR Cryptography and RSA cryptography, Firewall
Introduction to Wireless Network: Advantages and Disadvantages of Wireless Networks
Overview of 802.11 Wireless Networks: IEEE 802 Network Technology Family Tree, 802.11 Nomenclature and Design, Types of Wireless Networks, 802.11 Network Operations, Mobility Support.

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.
2. Matthew S. Gast, "802.11 Wireless Networks: The Definitive Guide", O'Reilly, Second Edition.

Reference Books:

1. B.A. Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A. S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition
3. S. Keshav, “An Engineering Approach to Computer Networking”, Addison Wesley.
4. Mayank Dave, “Computer Networks”, Cengage Learning India, First edition, 2012
4. Bhavneet Sidhu, “An Integrated Approach to Computer Networks”, Khanna Publications.
6. Comer, “Internetworking with TCP/IP", Vol. 1, Pearson Education, Fourth Edition.
7. W. Stallings, “Data and Computer Communications", Pearson Education, Fifth Edition.
8. B. A. Forouzan, “TCP/IP Protocol Suite", TMH, Fourth Edition.

Design and Analysis of Algorithms

COURSE OUTLINE

Course Title:	**Design and Analysis of Algorithms**	**Short Title:**	**DAA**	**Course Code:**	

Course description:

This course introduces concepts related to the design and analysis of algorithms. Specifically, it discusses recurrence relations, and illustrates their role in asymptotic and probabilistic analysis of algorithms. It covers in detail, divide and conquer techniques, greedy strategies, dynamic programming etc.

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

Prerequisite course(s):

Fundamental knowledge of Algorithm and Data Structure

Course objectives:

1. Learn mathematical background for analysis of algorithm.
2. Understand the concept of designing an algorithm.
3. Ability to analyze asymptotic runtime complexity of algorithms.

Course outcomes:

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

1. Understand and design of basic algorithms and computer time complexity.
2. Design and analyze algorithm by Divide and conquer approach.
3. Apply backtracking and Branch-bound approach to real word problem.
4. Simulate Greedy and Dynamic programming approach.
5. Recognize basic computational types of problem.

COURSE CONTENT

Design and Analysis of Algorithms		**Semester:**	**VI**
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 Algorithm:
Definition, Role of Algorithm in computing, Performance analysis: space and time complexity, Asymptotic notation and complexity issues, Analysis of Algorithm: Insertion sort and bubble sort, Recurrence: The Master Method

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

Divide and Conquer:
General strategy, analysis, Merge sort, Quick Sort, Binary Search- Analysis of algorithm
Hiring Problem, Indicator Random variable Problem, Randomized algorithms

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Backtracking: Introduction and Analysis, N Queens Problem, graph coloring Problem Branch and Bound: General Strategy and analysis, Traveling salesman's problem, knapsack problem, Single Source Shortest Path in directed acyclic Graph		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Greedy Algorithm and Dynamic Programming: Greedy Algorithms: General strategy, analysis, Huffman Code, Job sequencing, optimal merge patterns Dynamic Programming: Elements of dynamic programming, Multistage graph, Traveling salesman problem, 0/1 Knapsack Problem, Optimal Binary Search Tree		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Classification of problems: Non- deterministic algorithm, Satisfiability Problem, P, NP-Hard and NP- complete class with example, NP-Hard problems: code generation Problems, Approximation algorithm for NP-hard problems, Parallel Sorting Networks: The zero-one Principle, Parallel Merging Networks, Improved Sorting Networks		
Text Books:		
1. E. Thomas H. Cormen and Charles E.L. Leiserson, "Introduction to Algorithm", Third Edition, PHI. 2. Horowitz/Sahani, "Fundamentals of Computer Algorithm", Second Edition, Galgotia. 3. Gilles,Brassard and Paul Bratley, " Fundamentals of Algorithmics", PHI.		
Reference Books:		
1. Aho, "Design & Analysis of Computer Algorithms", Pearson LPE. 2. Russ Miller, "Algorithms: Sequential and Parallel", Dreamtech Press. 3. Goodrich, "Algorithm Design: Foundation and Analysis", Wiley India. 4. Grama , "An Intro to Parallel Computing : Design & Analysis of Algorithms", Second Edition, Pearson LPE. 5. Baase , "Computer Algorithms: Intro to Design & Analysis", Third Edition, Pearson LPE. 6. A. V. Aho and J.D. Ullman, "Design and Analysis of Algorithms", Pearson LPE. 7. Bressard, Bratly, "Fundamentals of Algorithm", Pearson LPE/PHI. 8. Simon Harris, "Beginning Algorithms" Wrox Press (Wiley India).		

Neural Networks (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Neural Networks**	**Short Title:**	**NN**	**Course Code:**	

Course description:

Neural networks provide a model of computation drastically different from traditional computers. Typically, neural networks are not explicitly programmed to perform a given task; rather, they learn to do the task from examples of desired input/output behavior. This course will cover basic neural network architectures and their learning algorithms. The students will have a chance to try out several of these models on practical problems.

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

Prerequisite course(s):

The course requires fundamental knowledge of computers and mathematics

Course objectives:

1. To study neural network
2. To study various neuron models
3. To study learning in neural network
4. To study perceptron
5. To study associative memory

Course outcomes:

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

1. Analyze the differences between computer and human brain.
2. Apply learning rules to artificial neural networks.
3. Analyze various architectures of artificial neural networks.
4. Enumerate perceptron
5. Enumerate the Associative Memory

COURSE CONTENT

Neural Networks		**Semester:**	**VI**
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 Neural Network:

Overview of Neural Networks, Artificial Neural Networks(ANN), Historical Development of Neural Networks, Biological Neural Networks, Comparison Between the Brain and Computer, Comparison Between Artificial and Biological Neural Network, Basic Building Blocks of ANN, ANN Terminologies

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

Fundamental Models of ANN:
McCulloch-Pitts Neuron Model
Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Competitive Learning Rule, Out Star Learning Rule, Boltzmann Learning, Memory Based Learning.
Hebb Net: Architecture, Algorithm, Linear Separability

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

Perceptron Networks:
Introduction to Perceptron
Single Layer Perceptron: Architecture, Algorithm, Application Procedure, Algorithm for Several Output Classes
Introduction to Multilayer Perceptron
Adaline : Architecture and Algorithm
Madaline: Architecture, MRI and MRII Algorithms

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

Associative Memory and Feedback Networks:
Associative Memory Networks: Introduction, Algorithms for Patterns Association
Hetero Associative Memory Neural Networks: Architectures
Auto Associative Memory Neural Networks: Architectures
Bi-directional Associative Memory: Architectures
Discrete Hopfield Net: Architecture, Training Algorithm Application Algorithm
Continuous Hopfield Net: Introduction

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

Feed Forward and Counter Propagation Network Networks:
Back Propagation Network: Architecture, Training Algorithm, Selection of Parameters, Learning in Back Propagation, Application Algorithm, Merits, Demerits and Applications
Kohonen Self Organizing Map: Architecture, Training Algorithm
Full Counter Propagation Network: Architecture, Training Phases, Training Algorithm
Forward Only Counter Propagation Network: Architecture, Training Algorithm

Text Books:

1. S N Sivanandan, S Sumathi, S N Deepa, "Introduction to Neural Networks using MATLAB 6.0", McGraw Hill Education Pvt Ltd. 17th Reprint 2013.

Reference Books:

1. S. Rajasekaran & G. A. V. Pai, "Neural Networks, Fuzzy logic, and Genetic Algorithms", PHI.
2. J.M.Zurda, "Introduction to Artificial Neural Networks", Jaico Publishing House.
3. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007
4. S. Haykin, "Neural Networks", Pearson Education, 2nd Ed., 2001.
5. K. Mehrotra, C. Mohan, and S. Ranka, *Elements of Artificial Neural Networks*, MIT Press, 1997.

Embedded Systems (Professional Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Embedded Systems**	**Short Title:**	**ES**	**Course Code:**	
Course description:					
This course introduce students the knowledge of Embedded System, Architecture of embedded system, programming and process of embedded system development, interfaces and real time OS concept.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Knowledge of Microprocessor/ Microcontroller and Operating System					
Course objectives:					
1. To understand Introduction and basic concept of Embedded System. 2. To gain knowledge of architecture of ES and its communication protocols. 3. To know the Embedded System Development Process. 4. To understand the concept of ARM architecture. 5. To gain knowledge about Real Time Operating System.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Explain the basic concept of Embedded System. 2. Describe Embedded System Architecture and its communication protocols. 3. Use process of Embedded System Development. 4. Apply concept of ARM architecture. 5. Explain Real Time Operating System.					
COURSE CONTENT					
Embedded Systems			**Semester:**	**VI**	
Teaching Scheme:			**Examination scheme:**		
Lectures:30	**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**		
Embedded System Introduction Applications of embedded systems, Categories of the Embedded System, Overview of Embedded System Architecture, Specialties of Embedded System, Recent trends in embedded systems					
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**		

Architecture of Embedded System Hardware architecture- CPU, Memory - SRAM, DRAM, Flash memory, Clock Circuitry, WDT, Chip Select, Communication Interfaces, communication protocols - SPI, I2C, CAN, Flexray. Software architecture- Services provided by an operating system, Architecture, Categories of embedded OS, Application software, Communication software		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Process of Embedded System Development The development process, Requirement engineering, Design, Implementation, Integration and Testing, Packaging, Configuration Management, Managing Embedded System development projects		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
RISC design philosophy, ARM design philosophy Embedded system hardware, Embedded system software, Registers, Current program status register, Pipeline, Exception, Interrupts Vector table, Architecture revision, ARM Processor families		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Real time Operating System Concept Architecture of kernel, Tasks & Task Scheduler, Interrupt Service Routines, Semaphores, Mutex, Mailbox, Message queues, Pipes, Event Register, Timers, Signals, Memory management, Priority Inversion Problem and Priority inheritance Introduction to uCOSII RTOS, Salient Features of uCOSII, Study of kernel structure of uCOSII		
Text Books:		
1. Dr. K.V.K.K. Prasad, "Embedded /Real-Time System: Concepts, Design &Programming", Dreamtech, Edition 2010. 2. Andrew. N. Sloss, Domnic Symes, Chris Wright, "ARM System Developer's Guide", Elsevier, edition 2004.		
Reference Books:		
1. Rajkamal, "Embedded Systems ", TMH. 2. Introduction to Embedded Systems, K.V. Shibu, McGraw Hill		

Image Processing (Professional Elective Course – II)

COURSE OUTLINE

Course Title:	**Image Processing**	**Short Title:**	**IP**	**Course Code:**	

Course description:

This course is an introduction to the fundamental concepts and techniques in basic digital image processing. The topics covered include Digital Image Fundamentals, Intensity Transformations and Spatial Filters, Filtering in the Frequency Domain, Image Restoration, Color Image Processing, Image Compression and Watermarking, Image Segmentation.

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

Prerequisite course(s):

Knowledge of Computer Graphics.

Course objectives:

1. To study the image fundamentals and image processing.
2. To study the image filtering.
3. To study image restoration.
4. To study the image compression and water marking
5. To study image segmentation.

Course outcomes:

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

1. Analyze general terminology of digital image processing.
2. Examine images in the frequency domain using filtering.
3. Evaluate the techniques for image restoration.
4. Interpret Image compression standards.
5. Interpret image segmentation techniques.

COURSE CONTENT

Image Processing		**Semester:**	**VI**
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: What is Digital Image Processing? Fundamental Steps in Digital Image Processing, Components of an Image Processing System

Digital Image Fundamentals: A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Some Basic Relationships Between Pixels: Neighbors of a Pixel, Adjacency, Connectivity, Regions, and Boundaries, Distance Measures

Intensity Transformations and Spatial Filtering: Basics of Intensity Transformations and

Spatial Filtering, Histogram Equalization, Histogram Matching (Specification), The Mechanics of Linear Spatial Filtering, Spatial Correlation and Convolution

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

Filtering in the Frequency Domain: The Basics of Filtering in the Frequency Domain: Additional Characteristics of the Frequency Domain, Frequency Domain Filtering Fundamentals, Summary of Steps for Filtering in the Frequency Domain, Correspondence Between Filtering in the Spatial and Frequency Domains,

Image Smoothing Using Lowpass Frequency Domain Filters: Ideal Lowpass Filters, Gaussian Lowpass Filters, Butterworth Lowpass Filters, Additional Examples of Lowpass Filtering,

Image Sharpening Using Highpass Filters: Ideal, Gaussian, and Butterworth Highpass Filters from Lowpass Filters, Homomorphic Filtering

Image Restoration: A Model of the Image Degradation/Restoration Process, Spatial and Frequency Properties of Noise, Periodic Noise,

Restoration in the Presence of Noise Only------Spatial Filtering: Mean Filters, Arithmetic Mean Filter, Geometric Mean Filter, Harmonic Mean Filter, Contraharmonic Mean Filter, Order-Statistic Filters, Median Filter, Max and Min Filters, Midpoint Filter, Alpha-Trimmed Mean Filter, Adaptive Filters, Adaptive, Local Noise Reduction Filter, Adaptive Median Filter,

Periodic Noise Reduction Using Frequency Domain Filtering: More on Notch Filtering, Optimum Notch Filtering

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

Color Image Processing: Color Fundamentals, Color Models: The RGB Color Model, The CMY and CMYK Color Models, The HSI Color Model, Converting Colors from RGB to HIS, Converting Colors from HSI to RGB, Manipulating HSI Component Images, A Device Independent Color Model, Basics of Full-Color Image Processing

Color Transformations: Formulation, Color Complements, Color Slicing, Tone and Color Corrections, Histogram Processing of Color Images

Color Image Smoothing and Sharpening: Color Image Smoothing, Color Image Sharpening

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

Image Compression and Watermarking: Fundamentals: Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information, Measuring Image Information, Shannon's First Theorem, Fidelity Criteria, Image Compression Models, The Encoding or Compression Process The Decoding or Decompression Process, Image Formats, Containers, and Compression Standards, Huffman Coding, Golomb Coding, Arithmetic Coding, Adaptive context dependent probability estimates, LZW Coding, Run-length Coding, One-dimensional CCITT compression, Two-dimensional CCITT compression, Symbol-based Coding, JBIG2 compression

Digital Image Watermarking		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Image Segmentation: Fundamentals, Point, Line, and Edge Detection: Background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, The Image Gradient and Its Properties, Gradient Operators, Combining the Gradient with Thresholding Thresholding: Foundation, The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding,The Role of Illumination and Reflectance in Image Thresholding, Basic Global Thresholding Segmentation by Region Growing and by Region Splitting and Merging: Region Growing, Region Splitting and Merging The Use of Motion in Segmentation: Spatial Techniques, A Basic Approach, Accumulative Differences, Establishing a Reference Image , Frequency Domain Techniques		
Text Books:		
1. Gonzalez and Woods, Digital Image Processing, 4th edition, Pearson/Prentice Hall		
Reference Books:		
1. B. Chanda, D. Datta Mujumdar, “Digital Image Processing And Analysis”, PHI , 2. William Pratt, “Digital Image Processing”, John Willey & Sons 3. Anil Jain, “Fundamentals Of Digital Image Processing”, PHI		

Software Metrics and Quality Assurance (Professional Elective Course – II)

COURSE OUTLINE

Course Title:	**Software Metrics and Quality Assurance**	**Short Title:**	**SMQA**	**Course Code:**	

Course description:

This course covers the importance of software measurement and metrics, aspects of software quality, know scope of software metrics. Learn internal product attributes, external product attributes and cost estimation, measurement models. It describes software quality and quality assurance techniques. Course included the concept of automation tools for software testing.

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

Prerequisite course(s):

Software Engineering.

Course objectives:

The objective of this course is to

1. Learn scope of software metrics.
2. Know various cost estimation and reliability growth models.
3. Understand the importance of software quality assurance for software system development.
4. Know the concept of automation testing and tools used for software testing.

Course outcomes:

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

1. Use of basic reliability theory and reliability growth models to analyze software reliability.
2. Use of cost estimation models to estimate cost of software development.
3. Demonstrate knowledge about quality management, assurance, and quality standard of Software system.
4. Apply automation tools for various software testing.
5. Apply and analyze effectiveness of software quality tools.

COURSE CONTENT

Software Metrics and Quality Assurance		**Semester:**	**VI**
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**

Software measurements: measurement in software engineering, scope of software metrics, the representational theory of measurement, measurement and models, measurements scales and scale types, meaningfulness in measurement, classifying software measures, applying the framework, software measurement validation.

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

Measuring internal product attribute Size - Aspects of software size. Length, Reuse, Functionality, Complexity. Measuring internal product attributes: structure- types of structural measures, Control-flow structure, Modularity and information flow attributes.

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

Modeling software quality, measuring aspect of software quality, software reliability: Basics of reliability theory, software reliability problem, parametric reliability growth models, cost estimation: problem and approaches, model of effort and cost : regression based model and COCOMO.

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

Software Quality, software quality dilemma, achieving software quality assurance elements of SQA, SQA tasks, goals, and metrics, formal approaches to SQA, statistical software quality assurance, six sigma for software engineering, ISO 9000 Quality standards, SQA Plan, SEI's CMM model.

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

Software test automation-What is test automation, terms used in automation, skills needed for automation, what to automate, scope of automation, design and architecture of automation, generic requirement for test tool, process model for automation, selecting test tool, automation for XP/Agile model, challenges in automation, data-driven testing, automation tools like JUnit, Jmeter.

Text Books:

1. Norman E. Fenton & Shari Lawrence Pfleeger, "Software Metrics A Rigorous & Practical Approach", THOMSON, International Student Edition, 2nd Edition.
2. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata McGraw Hill, ISBN : 9780070139909 0070139903, 1st Edition.
3. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN -10: 817758121X, 1st Edition.

Reference Books:

1. Rajiv Chopra, "Software Testing a Practical Approach", KATSON BOOKS, 3rdEdition.
2. Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN – 10: 0198061846. ISBN - 13: 9780198061847.
3. Rajiv Chopra, "Software Testing a Practical Approach", KATSON BOOKS, 3rdEdition.
4. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN - 10: 0133988082; ISBN -13: 978-0133988086, 2nd Edition.
5. Mordechai Ben - menachem/Garry S. Marliss, "Software Quality", Thompson Learning.
6. Ron Patton,"Software Testing", Pearson Education ISBN -13: 978-0-672 - 32798-8, 2ndEdition.

Project Management (Open Elective Course – II)

COURSE OUTLINE

Course Title:	**Project Management**	**Short Title:**	**PM**	**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:

1. To learn the concepts of project management.
2. To understand the concept of project planning & scheduling tools.
3. To understand project risk management.
4. To know the project procurement management.

Course outcomes:

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

1. Use and explain different stages of project management
2. Make use of project planning and scheduling tools
3. Know the methods of cost estimation of project
4. Apply project risk management for controlling risk
5. Understand the procurement management for the project

COURSE CONTENT

Project Management		**Semester:**	**VI**
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 Project Management: What Is a Project? , Project Attributes, The Triple Constraint , What Is Project Management?, Project Stakeholders, Project Management Knowledge Areas, Project Management Tools and Techniques, Program and Project Portfolio Management, The Role of the Project Manager: Project Manager Job Description, Suggested Skills for Project Managers, Importance of People and Leadership Skills, Careers for Information Technology Project Managers, The Project Management Profession, History of Project Management, Ethics in Project Management, Project Management Software

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Project Time Management: The Importance of Project Schedules, Defining Activities, Sequencing Activities, Estimating Activity Resources, Estimating Activity Durations, Developing the Schedule: Gantt Charts, Critical Path Method, Critical Chain Scheduling, Program Evaluation and Review Technique (PERT), Controlling the Schedule, Using Software to Assist in Project Time Management, Words of Caution on Using Project Management Software		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Project Cost Management: The Importance of Project Cost Management, Basic Principles of Cost Management, Estimating Costs: Types of Cost Estimates, Cost Estimation Tools and Techniques, Typical Problems with Information Technology Cost Estimates, Sample Cost Estimate, Determining the Budget, Controlling Costs, Earned Value Management, Project Portfolio Management, Using Project Management Software to Assist in Project Cost Management		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Project Risk Management: The Importance of Project Risk Management, Planning Risk Management, Common Sources of Risk on Information Technology Projects, Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Planning Risk Responses, Monitoring and Controlling Risks, Using Software to Assist in Project Risk Management		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Project Procurement Management: The Importance of Project Procurement Management, Planning Procurements: Tools and Techniques for Planning Procurements, Procurement Management Plan, Statement of Work, Procurement Documents, Source Selection Criteria, Conducting Procurements, Administering Procurements, Closing Procurements, Using Software to Assist in Project Procurement Management		
Text Books:		
1.Kathy Schwalbe, Information Technology Project Management Cengage Learning, 7th Edition		
Reference Books:		
1. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India, 2002. 3rd Edition. 2. Rangwala, Estimation, Costing and Valuation, Charotar Publishing House. 3. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002. 2nd Edition. 4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher, 3rd Edition. 5. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2009. 7th Edition.		

Managing Innovation and Entrepreneurship (Open Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Management Innovation and Entrepreneurship**	**Short Title:**	**MIE**	**Course Code:**	
Course description:					
The course attempts to present the various aspects of entrepreneurship and innovation management.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	**14**	**42**	**3**	
Prerequisite course(s):					
Course objectives:					
1. To provide theoretical foundations of entrepreneurship development and Innovation Management 2. To acquaint students with emerging areas in Entrepreneurship and Innovations 3. To create awareness among students to become successful Entrepreneur					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Define the basic theories mentioned in syllabus, schemes and supports available for entrepreneurs from various nodal agencies. 2. Determine the basic aspects of Project Report & Project Appraisal 3. Design and formulate the Project report, Business Plan 4. Understand the importance of Product evaluationprocess and legal aspects of Innovation. 5. Discuss the significance of creativity.					
COURSE CONTENT					
Management Innovation and Entrepreneurship		**Semester:**	**VI**		
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**			
Entrepreneur & Entrepreneurship • Entrepreneur-Meaning, Functions, Characteristics, Types • Entrepreneurship- Concept, Factors affecting Entrepreneurial Growth-Economic, non economic factors, Government action • Role of Entrepreneurship in Economic development • Women Entrepreneurship-Concept, Functions, Problems of Women Entrepreneurs, Self Help Groups • Rural Entrepreneurship- Meaning, Need, Problems, Ways to develop Rural entrepreneurship, Role of NGOs.					

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

Entrepreneurship Development

- Entrepreneurship Development Programmes (EDPs)- Concept, Need for EDP's, Objectives of EDP's
- Course contents and curriculum of EDP's, Phases of EDPs, Problem faced by EDPs
- Role of following agencies in the Entrepreneurship Development
  - DIC-District Industrial Centers
  - SISI-Small Industries Service Institutes
  - SSIB- Small Scale Industries Board
  - SIDO- Small Industries Development Organization

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

Project Formulation & Appraisal

Project Report-Meaning, Significance, Contents, Formulation of Project Report

- Planning commission guidelines for formulating a project report
- Project Appraisal- Concept, Methods of Project Appraisal

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

Innovation and Creativity

Innovation- Concept, Characteristics, Components, Sources and Types

- Creativity- Concept, Creativity Process, Impact of Innovation
- Individual Creativity- Motivation to creativity, Blocks to Creativity, Strategies for unblocking creativity
- Innovation Management- Concept, Scope, Characteristics, Significance.
- Innovation Environment- Key drivers of Innovation, Factors influencing Innovation, Nurturing innovation in E-Business

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

Managing Innovation

Product Innovation- Introduction, Significance, Product development strategies, Packaging innovations.

- Process Innovations-Introduction, types of process innovations, work simplification, Kaizen, Six Sigma, Business Process Reengineering (BPR)
- Legal aspects of Innovation- Introduction, safeguarding innovation, Concept of IPR, Benefits from Patents, IPR in international settings, Patenting trends and challenges

Text Books:

1. Entrepreneurial Development- S.S. Khanka, S. Chand & Company Ltd, 2008 Edition.
2. Innovation Management- C.S.G. Krishnamacharyulu & Lalitha R, Himalaya Publishing House, Second revised edition 2013House, Second revised edition 2013.

Reference Books:

1. Dynamics of Entrepreneurship development and Management- Vasant Desai, Himalaya Publishing.
2. Entrepreneurship Development and Project Management- Neeta Baporikar, Himalaya

Publishing
3. Entrepreneurship Development in India-Gupta, Srinivasan, Sultan Chand & Sons.
4. Innovation Management by Vinnie Jauhari & Sudhanshu Bhushan Oxford publications
5. Managing Technology and Innovation for Competitive Advantage by V.K. Narayanan – Pearson LPE

Supply Chain Management-Planning (Open Elective Course – II)					
COURSE OUTLINE					
Course Title:	**Supply Chain Management-Planning**	**Short Title:**	**SCM**	**Course Code:**	

Course description:

Students develop the ability to conceptualize, design, and implement supply chains aligned with product, market, and customer characteristics. Business competition is now between supply networks rather than individual corporations. Managing the flow of products, information, and revenue across supply chains differentiates the ability of supply networks to fulfill customer needs.

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

Prerequisite course(s):

Course objectives:

1.Conceptualize supply chain designs, which are aligned with business models for manufacturing and service companies
2. Manage inventory efficiently and pool inventory risks across time, products, channels, and geography.
3. Design supply chain contracts for effective governance of supply chain relationships.
4. Align supply chain integration strategy with the uncertainty conditions of supply and demand.
5. Determine the IT infrastructure requirements and IT integration strategy for supply chain management.
6.Determine the decision support system requirements for supply chain management.

Course outcomes:

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

1. Explain fundamental supply chain management concepts.
2. Apply knowledge to evaluate and manage an effective supply chain.
3. Analyze and improve supply chain processes.
4. Discuss inventory management controls.
5. Design transportation network.

COURSE CONTENT

Supply Chain Management-Planning		**Semester:**	**VI**
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 Supply Chain- Supply chain systems, stages and decision phases and process view of supply chain; supply chain flows; examples of supply chains; competitive supply chain strategies; drivers for supply chain performance.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Designing the Supply Chain Network- Distribution Networking – role, design; Supply Chain Network – SCN- Role, factors; framework for design decisions.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Facility Location and Network Design- Models for facility location and capacity location; Impact of uncertainty on SCN – discounted cash flow analysis; evaluating network design decisions using decision trees.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Planning and Managing Inventories in a Supply Chain- Inventory concepts, trade promotions; managing multi-echelon cycle inventory, safety inventory determination; impact of supply uncertainty aggregation and replenishment.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Sourcing, Transportation and Pricing Products-Role of sourcing, supplier- scoring and assessment, selection and contracts, design collaboration; role of transportation, modes of transportation and designing transportation network. The role of revenue management. in a Supply chain. Information technology in a Supply chain.		
Text Books:		
1. Sunil Chopra ,Peter M, and D.V. Kalra Supply Chain Management, Pearson publishing, 2007 2. Janat Shah, Supply Chain Management, Pearson publishing, 2009		
Reference Books:		
1. Hugos, M., Essentials of supply chain management. (2nd ed.). New Jersey: John Wiley & Sons, 2006		

Information Sources and Literacy (Open Elective Course – II)

COURSE OUTLINE

Course Title:	**Information Sources and Literacy**	**Short Title:**	**ISL**	**Course Code:**	

Course description:

Information Literacy aims to respond to problems, errors and gaps in Web information retrieval that have been identified worldwide, even among younger generations. It has been acknowledged that technology competency is distinct from information competency and therefore does not provide adequate solutions for Internet information searching complexities. Easy and extended access to information is causing end-user overload and leading to difficulties in identifying, evaluating, selecting, locating and accessing relevant and reliable information sources that can address specific information needs.

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

Prerequisite course(s):

Course objectives:

1. Define the nature and extent of the information needed,
2. Identify types of information resources available
3. Locate or access information resources on topic
4. Evaluate information resources found

Course outcomes:

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

1. Identify major and related concepts of their information need
2. Apply finding aid to use to locate the various types of information resources
3. Classify the resources found in the library or through the library's electronic resources.
4. Summarize or compare and contrast main ideas found in information resources.
5. Choose various documentation styles

COURSE CONTENT

Information Sources and Literacy		**Semester:**	**VI**
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**

Information sources and types : documentary and non-documentary, Print information sources: primary, secondary, tertiary, Electronic information sources: primary, secondary, tertiary, Books: concept, parts: front matter, body, back matter; types, Journals: concept, types, impact factor, h-index, Theses: concept, parts, Criteria for Evaluation of Information Sources

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

Full text databases: Science Direct, Emerald, Abstracting and indexing databases: Medline, Citational databases: Scopus, Web of Science, Theses databases: NDLTD, Shodhganga, Open access resources: DOAJ, DOAB, DOAR		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
MOOC, National Knowledge Network, National Digital Library, INDEST Consortia, NPTEL, CEC, E-pathshala, e-PG Pathshala, e-Yantra, SWAYAM, NList, e-ShodhSindhu, Virtual Labs, Spoken Tutorial, Oscar++, Other non-governmental e resources: Open Culture, Khan Academy		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Information literacy: meaning and scope, Writing a Research Paper: Components of a Research Paper, Citation Styles: APA, Chicago, MLA, Vancouver, Using MS Word for writing a Research Paper, Structure of a research proposal, Research Report Writing		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
OPAC: Searching the OPAC, Search Engines: How do the search engines work? Precision, Recall, Steps to improve precision, Search optimization, search operators, Keyword and Phrase Search, Keyword and Subject Search, Boolean Search, Truncation Search, Proximity Search, Field-specific Search, Limiting Search, Range Search, Federated Search Vocabulary control: features of Natural language and controlled language, Exact match, best match and partial match search results, Web information retrieval, intelligent information retrieval Literature search: How to search the latest literature		
Text Books:		
1. Eisenberg, Michael. Information literacy: Essential skills for the information age. 2nd ed. Westport Publ.: Libraries Unlimited, 2005. 2. Gates, Jean Key. (1988). Guide to the use of Libraries and Information Sources (6thed). New York: McGraw-Hill.		
Reference Books:		
1. Katz, William A. (2002). Introduction to Reference Work: Basic Information Services, Introduction to Reference Work: V1. 8thed. New York: McGraw-Hill, 2002. 2. Katz, William A. (2002). Introduction to Reference Work: Reference Services and Reference Processes. V2. 8thed. New York: McGraw-Hill.		

OPERATING SYSTEMS LAB					
LAB COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS LAB**	**Short Title:**	**OSL**	**Course Code:**	
Course description:					
This laboratory provides students with a comprehensive study of the operating system functions, its working details and implementation of various algorithms used in the operating systems.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	2	**14**	**28**	**1**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**			
Prerequisite course(s):					
C Programming, Computer Organisation, System Programming					
Course objectives:					
1. To understand and implement concept of file handling and process scheduling. 2. To study problems of deadlock and semaphore and provide practical solutions to it. 3. To understand the memory management concept and its implementation. 4. To study and implement file allocation and organization techniques. 5. To understand and implement disk scheduling algorithms.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Apply concept of file handling and process scheduling. 2. Identify problems of deadlock and semaphore. 3. Apply concept of memory management. 4. Design a file allocation and organization techniques. 5. Solve disk scheduling algorithms.					
LAB COURSE CONTENT					
OPERATING SYSTEMS LAB		**Semester:**	**VI**		
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 at least EIGHT Laboratory assignments from the following list.

1. Write a C program for File Handling for following File handling operation (Any three)

a. create
b. open
c. read
d. write
e. append
f. copy
g. rename

2. Write a C program to implement CPU Scheduling algorithms(Any one)

a. FCFS
b. SJF(Preemptive& non-preemptive)

c. Round Robin
d. Priority based (Preemptive& non-preemptive)

3. Write a C program for Banker's algorithm for the purpose of Deadlock avoidance

4. Write a C program to simulate Producer-Consumer problem using Semaphore

5. Write a C program to simulate Dinning Philosopher problem

6. Write a C program to implement following Memory Management algorithms(Any one)
a. First Fit
b. Best Fit
c. Worst Fit

7. Write a C program to simulate Paging technique of Memory management

8. Write a C program to simulate following file allocation strategies (Any one)
a. Sequential
b. Linked
c. Indexed

9. Write a C program to simulate the following file organisation technique (Any one)
a. Single level directory
b. Two level directory
c. Hierarchical

10. Write a C program to implement Page Replacement algorithms(Any one)
a. FIFO(First In First Out)
b. LRU(Least Recently Used)
c. Optimal

11. Write a C program to demonstrate disk scheduling algorithms(Any one)
a. FCFS
b. SSTF
c. SCAN
d. C-SCAN

12. Write a C program for Interprocess communication.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Book:

1. Operating Systems Concepts – Silberschatz, Galvin, Wiley Publications (2008),9E

Reference Books:

1.Operating Systems – William Stallings, Pearson Education Asia (2002)

2.Operating Systems - Nutt, Pearson Education Asia (2003)
3.Modern Operating Systems - Andrew S. Tenenbaum, Pearson Education Asia / PHI (2005)
2.UNIX System Programming Using C++,by Terrence Chan: Prentice Hall India, 1999

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.

Computer Networks Lab

LAB COURSE OUTLINE

Course Title:	**Computer Networks Lab**	**Short Title:**	**CNL**	**Course Code:**	

Course description:

This laboratory provides students with a comprehensive study of the Computer Networking and protocols. Classroom lectures stress the strengths of Computer Networks, which provide students with the means of writing efficient, maintainable, and portable code and simulating protocols and networks.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Fundamental knowledge of Computers and Data Communication, C and Java Programming.

Course objectives:

1. To study TCP/IP protocol suite
2. To study TCP and UDP client-server socket
3. To study cryptography
4. To study routing protocols
5. To study network simulator environment

Course outcomes:

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

1. Apply the concept of bit stuffing in framing.
2. Use Run Length Encoding for data compression.
3. Demonstrate client server communication using TCP and UDP Socket.
4. Develop Cryptographic algorithms.
5. Build the network scenario in network simulation tool.

LAB COURSE CONTENT

Computer Networks Lab		**Semester:**	**VI**
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 at least FOUR Laboratory assignments from Group - A and ALL Laboratory assignments from Group – B from the following list.

(Group A)

1. Implementation of Bit-Stuffing and Un-stuffing in Framing
2. Implementation of RLE data compression algorithm.
3. Implementation of TCP checksum.
4. Implementation of ARP Protocol.

5. Generation of UDP Header
6. Implementation of TCP Socket.
7. Implementation of UDP Socket.
8. Encryption/Decryption using XOR symmetric-key cryptography algorithm.
9. Encryption/Decryption using RSA asymmetric-key cryptography algorithm.

(Group B)

1. Simulation of TCP agent in NS2
2. Simulation of UDP agent in NS2
3. Configuring DHCP, DNS, SMTP and HTTP Server in any Packet Tracer
4. Configuring Static and Dynamic Routing Protocols in any Packet Tracer

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.
2. Teerawat Issariyakul and Ekram Hossain, “Introduction to Network simulator NS2” Springer, Second Edition.

Reference Books:

1.B.A.Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A. S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition
3. S. Keshav, “An Engineering Approach to Computer Networking”, Addison Wesley.
4. Mayank Dave, “Computer Networks”, Cengage Learning India, First edition, 2012
4. BhavneetSidhu, “An Integrated Approach to Computer Networks”, Khanna Publications.
6. Comer, “Internetworking with TCP/IP", Vol. 1, Pearson Education, Fourth Edition.
7. W. Stallings, “Data and Computer Communications", Pearson Education, Fifth Edition.
8. B. A. Forouzan, “TCP/IP Protocol Suite", TMH, Fourth 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.

Design and Analysis of Algorithms Lab

LAB COURSE OUTLINE

Course Title:	**Design and Analysis of Algorithms Lab**	**Short Title:**	**DAAL**	**Course Code:**	

Course description:

Demonstrate knowledge of the basic algorithm strategies such as divide and conquer, Greedy method, Dynamic programming, backing tracking and branch and bounding.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**14**	**28**	**1**

End Semester Exam (ESE) Pattern: **--**

Prerequisite course(s):

Knowledge of programming language and Design and analysis of Algorithm

Course objectives:

1. Understand & Implement the concept of designing an algorithm.
2. Ability to analyze asymptotic runtime complexity of algorithms.

Course outcomes:

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

1. Analyze and Implement divide and conquer approach.
2. Implement dynamic programming approach.
3. Implement Branch and bounding approach.
4. Implement backtracking approach.
5. Implement greedy algorithm approach.

LAB COURSE CONTENT

Design and Analysis of Algorithms Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

Concerned faculty member should suitably frame ALL Laboratory assignments from the following list.

1. Analyze & Implement Insertion sort / Bubble sort algorithm
2. Analyze & Implement Quick sort/ Merge sort algorithm using Divide and Conqure.
3. Implement 0/1 Knapsack / Optimal Binary Search Tree using Dynamic Programming
4. Implement Travel Salesman Problem/ knapsack problem using Branch and Bounding
5. Implement n-queens / graph coloring Problem using backtracking
6. Implement job sequencing / Huffman Code Algorithm using Greedy Algorithm

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. E. Thomas H. Cormen and Charles E.L. Leiserson, "Introduction to Algorithm", Third Edition, PHI.
2. Horowitz/Sahani, "Fundamentals of Computer Algorithm", Second Edition,Galgotia.
3. Gilles, Brassard and Paul Bratley, " Fundamentals of Algorithmics", PHI.

Reference Books:

1. Aho, "Design & Analysis of Computer Algorithms", Pearson LPE.
2. Russ Miller, "Algorithms: Sequential and Parallel", Dreamtech Press.
3. Goodrich, "Algorithm Design: Foundation and Analysis", Wiley India.
4. Grama , "An Intro to Parallel Computing : Design & Analysis of Algorithms", Second Edition, Pearson LPE.
5. Baase , "Computer Algorithms: Intro to Design & Analysis", Third Edition, Pearson LPE

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.

Minor Project

LAB COURSE OUTLINE

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

Course description:

Minor project represent the culmination of study towards the Bachelor of Engineering degree. The minor 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**
	6	**14**	**84**	**3**

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

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 Minor Project (Stage – I) at Semester – V, by the end of Semester – VI, the student should complete implementation of ideas as formulated in Minor Project (Stage – I). It may involve coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VI 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
- 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 (TestcaseID, Input, Output, Expected Output, Actual Output, Result (Pass/Fail) etc.)

Chapter 7. Results and Discussion

Chapter 8. Conclusion & Future Work

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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 Minor Project in Semester – VI 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.

Internship - II

Internship is a mandatory and non-credit course. It is mandatory for all admitted students to undergo Internship during the degree course. The course shall be of THREE weeks duration during summer vacation after Semester - VI. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Students shall choose to undergo Internship / Innovation / Entrepreneurship related activities for Internship. Students shall choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations / Micro / Small / Medium enterprises / academic institutions / research institutions. In case student want to pursue their family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the Department Head / TPO.

During the last year of FOUR year Bachelor of Engineering course the student should take project work, as specified in the curriculum, based on the knowledge acquired by the student during the degree course and during Internship. The project work provides an opportunity to build a system based on area where the student likes to acquire specialized skills. The work may also be on specified task or project assigned to the student during Internship.

The internship activities and list of sub-activities for Internship are as under.

- Innovation / Entrepreneurship:
    - Participation in innovation related Competitions for eg. Hackathons, Robocon, Baha, IIT TechFest, Chemcon, Dipexetc
    - Development of new product/ Business Plan/ registration of start-up
    - Participation in Entrepreneurship Program of THREE weeks duration
    - Online certification courses by SWAYAM, NPTEL, QEEE etc.
    - Working for consultancy/ research project within the institutes
    - Training on Software (As per the need of respective branch);
    - Field Survey / Case Study
    - Work experience at family business
- Internship:
    - Internship with Industry/Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ academic institutions / research institutions
    - Online Internship
- Rural Internship

- Any Long Term Goals may be carried out by students in teams:
  - Prepare and implement plan to create local job opportunities.
  - Prepare and implement plan to improve education quality in village.
  - Prepare an actionable DPR for doubling the village Income.
  - Developing Sustainable Water Management system.
  - Prepare and Improve a plan to improve health parameters of villagers.
  - Developing and implementing of Low Cost Sanitation facilities.
  - Prepare and implement plan to promote Local Tourism through Innovative Approaches.
  - Implement/Develop Technology solutions which will improve quality of life.
  - Prepare and implement solution for energy conservation.
  - Prepare and implement plan to Skill village youth and provide employment.
  - Develop localized techniques for Reduction in construction Cost.
  - Prepare and implement plan of sustainable growth of village.
  - Setting of Information imparting club for women leading to contribution in social and economic issues.
  - Developing and managing efficient garbage disposable system.
  - Contribution to any national level initiative of Government of India. For eg. Digital India/ Skill India/ Swachh Bharat Internship etc.

Faculty Mentor/Supervisors have to play active roles during the internship and minimum 20 students are to be supervised by each faculty mentor or as per the departmental strength. Mentor shall be responsible for selection of Internship activities by the student under his/her supervision and shall avoid repetition of activities by the student. The college / Institute shall facilitate internship for the students.

Every student is required to prepare a file for Internship containing documentary proofs (daily training diary, comprehensive report and completion certificate) of the activities done by him/her. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should include Date, Time of Arrival, Time of Departure, Main points of the day. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working.

After completion of Internship, the student should prepare a comprehensive report to indicate what he / she has observed and learnt in the training period. The report should include Internship Objectives (in measurable terms), Internship Activities, and Internship Outcome.

The completion certificate should be signed by the supervisor / in charge of the section where the student has been working with performance remark as Satisfactory / Good / Excellent.

The evaluation of Internship shall be in Semester – VII. The evaluation shall be done by expert committee constituted by the concerned department including Department Head/ TPO/ faculty mentor or guide. It should be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Originality.
- Adequacy and purposeful write-up.
- Practical applications, relationships with basic theory and concepts taught in the course.
- Skill / knowledge acquired

Hence the satisfactory completion of Internship shall be submitted to the university at the end of Semester - VIII of FOUR year Bachelor of Engineering course. Only after successfully completion of Internship, Internship should be printed in the final year mark sheet as COMPLETED.