JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURJADA VIZIANAGARAM
VIZIANAGARAM – 535 003, Andhra Pradesh, India
B.Tech CSE (R23-COURSE STRUCTURE & SYLLABUS)

COURSE STRUCTURE (R23) –B.TECH CSE
(Applicable from the academic year 2023-24 and onwards)

B. Tech – I Year I Semester

S.No.	Category	Title	L/D	T	P	Credits
1	BS&H	Engineering Physics	3	0	0	3
2	BS&H	Linear Algebra & Calculus	3	0	0	3
3	Engineering Science	Basic Electrical & Electronics Engineering	3	0	0	3
4	Engineering Science	Engineering Graphics	1	0	4	3
5	Engineering Science	Introduction to Programming	3	0	0	3
6	Engineering Science	IT Workshop	0	0	2	1
7	BS&H	Engineering Physics Lab	0	0	2	1
8	Engineering Science	Electrical & Electronics Engineering Workshop	0	0	3	1.5
9	Engineering Science	Computer Programming Lab	0	0	3	1.5
10	BS&H	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5
Total			**13**	**00**	**15**	**20.5**

B. Tech – I Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	BS&H	Communicative English	2	0	0	2
2	BS&H	Engineering Chemistry	3	0	0	3
3	BS&H	Differential Equations & Vector Calculus	3	0	0	3
4	Engineering Science	Basic Civil & Mechanical Engineering	3	0	0	3
5	Professional Core	Data structures	3	0	0	3
6	BS&H	Communicative English Lab	0	0	2	1
7	BS&H	Engineering Chemistry Lab	0	0	2	1
8	Engineering Science	Engineering Workshop	0	0	3	1.5
9	Professional Core	Data structures Lab	0	0	3	1.5
10		Health and wellness, Yoga and Sports	-	-	1	0.5
Total			**14**	**00**	**11**	**19.5**

B.Tech. II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS&H	Discrete Mathematics & Graph Theory	3	0	0	3
2	BS&H	Universal Human Values–Understanding Harmony	2	1	0	3
3	Engineering Science	Digital Logic &Computer Organization	3	0	0	3
4	Professional Core	Software Engineering	3	0	0	3
5	Professional Core	Object Oriented Programming Through Java	3	0	0	3
6	Professional Core	CASE Tools Lab	0	0	3	1.5
7	Professional Core	Object Oriented Programming Through Java Lab	0	0	3	1.5
8	Skill Enhancement Course	Python Programming	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
Total			**16**	**2**	**8**	**20**

B.Tech. II Year II Semester

S.No.	**Category**	**Title**	**L**	**T**	**P**	**Credits**
1	Management Course- I	Managerial Economics and Financial Analysis	2	0	0	2
2	Engineering Science/ Basic Science	Probability & Statistics	3	0	0	3
3	Professional Core	Operating Systems	3	0	0	3
4	Professional Core	Database Management Systems	3	0	0	3
5	Professional Core	Formal Languages and Automata Theory	2	1	0	3
6	Professional Core	Operating Systems Lab	0	0	3	1.5
7	Professional Core	Database Management Systems Lab	0	0	3	1.5
8	Skill Enhancement Course	Full Stack Development –I	0	1	2	2
9	BS&H	Design Thinking&Innovation	1	0	2	2
Total			**14**	**2**	**10**	**21**

Mandatory Community Service Project Internship of 08 weeks duration during summer vacation					
MC	Minor Course (Student may select from the specialized minors pool)	3	0	3	4.5
HC	Honors Course (Student may select from the honors pool)	3	0	0	3

Course Structure (Draft)

B.Tech. – III Year I Semester

S.No	Category	Title	L	T	P	Credits
1	Professional Core	Data Warehousing and Data Mining	3	0	0	3
2	Professional Core	Compiler Design	3	0	0	3
3	Professional Core	Design and Analysis of Algorithms	3	0	0	3
4	Professional Elective-I	1. Object Oriented Analysis and Design 2. Software Testing Methodologies 3. Microprocessors & Microcontrollers 4. Computer Architecture 5. Computer Graphics 6. 12 week MOOC Swayam/ NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective-I		3	0	0	3
6	Professional Core	Data Mining Lab	0	0	3	1.5
7	Professional Core	Compiler DesignLab	0	0	3	1.5
8	Skill Enhancement course	Full Stack development-2	0	1	2	2
9	Engineering Science	User Interface Design using Flutter / SWAYAM Plus - Android Application Development (with Flutter)	0	0	2	1
10	Evaluation of Community Service Internship		-	-	-	2
	Total		15	1	10	23
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3

MC	Minor Course through SWAYAM/NPTEL (minimum 12 week, 3 credit course)	3	0	0	3
HC	Honors Course (Student may select from the same honors pool)	3	0	0	3
HC	Honors Course (Student may select from the same honors pool)	3	0	0	3

B.Tech. III Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Computer Networks	3	0	0	3
2	Professional Core	Artificial Intelligence	3	0	0	3
3	Professional Core	Cryptography & Network Security	3	0	0	3
4	Professional Elective-II	1. Cloud Computing 2. Cyber Security 3. DevOps 4. No SQL Databases 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Professional Elective-III	1. Software Project Management 2. Natural Language Processing 3. Big Data Analytics 4. Distributed System 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
6	Open Elective – II		3	0	0	3
7	Professional Core	AI Tools Lab	0	0	3	1.5
8	Professional Core	Computer Network Lab	0	0	3	1.5
9	Skill Enhancement course	Soft skills / / SWAYAM Plus - 21st Century Employability Skills	0	1	2	2
10	Audit Course	Technical Paper Writing &IPR	2	0	0	-
Total			**20**	**1**	**08**	**23**
Mandatory Industry Internship / Mini Project of 08 weeks duration during summer vacation						
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	3	4.5
HC	Honors Course (Student may select from the same honors pool)		3	0	0	3

* Under Industry Internship interested students can pursue SWAYAM Plus courses viz., Hands-on Masterclass on Data Analytics OR Artificial Intelligence for Real-World Application

B.Tech. IV Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Machine Learning	2	1	0	3
2	Management Course- II	Human Resources & Project Management	2	0	0	2
3	Professional Elective-IV	1. Software Architecture & Design Patterns 2. Blockchain Technology 3. Internet of Things 4. Quantum Computing 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
4	Professional Elective-V	1. Soft Computing 2. Human Computer Interaction 3. Digital Image Processing 4. Mobile Adhoc Networks 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective-III		3	0	0	3
6	Open Elective-IV		3	0	0	3
7	Skill Enhancement Course	Prompt Engineering/ SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	0	1	2	2
8	Audit Course	Constitution of India	2	0	0	-
9	Internship	Evaluation of Industry Internship / Mini Project	-	-	-	2
		Total	**18**	**2**	**02**	**21**
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC	Honors Course (Student may select from the same honors pool)		3	0	0	3
HC	Honors Course (Student may select from the same honors pool)		3	0	0	3

B.Tech IV Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Internship & Project Work	Full semester Internship & Project Work	0	0	24	12

Note : ***Student need to do at least ONE MOOC/NPTEL Course (of 3 credits out of 160 credits) to meet the mandatory requirement (11th criteria, as per R23 Regulations); they are allowed to register one semester in advance***

Open Electives, offered to other department students:

Open Elective I: Principles of Operating Systems/ Computer Organization and Architecture
Open Elective II: Principles of Database Management Systems
Open Elective III: Object Oriented Programming Through Java
Open Elective IV: Principles of Software Engineering /Computer Networks

Minor Engineering

Note:

1. *To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.*
2. *During Minor/Honors Course selection, there should not be any overlapping with Regular/Major/OPEN Electives*

Minor in CSE

1. Principles of Database Management Systems 3-0-3-4.5 (II-II)
2. Principles of Software Engineering 3-0-0-3 (III-I)
3. Advanced Data Structures & Algorithm Analysis 3-0-3-4.5 (III-II)
4. Principles of Operating Systems 3-0-0-3 (IV-I)

Any of the following 12 Week 3 credit NPTEL MOOC Courses

5. Artificial Intelligence: Knowledge Representation and Reasoning
6. Computer Networks and Internet Protocol
7. Machine Learning and Deep Learning - Fundamentals and Applications
8. Fundamentals of Object Oriented Programming
9. Discrete Mathematics for CS
10. Software Engineering
11.

COURSES OFFERED FOR HONORS DEGREE IN CSE

Note: ***To obtain Honor's degree, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.***

1. Social Network Analysis 12 Week 3 Credit Course, MOOCS
2. Applied Linear Algebra in AI & ML 12 Week 3 Credit Course, MOOCS
3. Design & Implementation of Human-Computer Interfaces – NPTEL MOOCS
4. Cryptography and Network Security 12 Week 3 Credit Course, MOOCS
5. Privacy and Security in Online Social Media 12 Week 3 Credit Course, MOOCS
6. Deep Learning for Natural Language Processing - 12 Week 3 Credit Course, MOOCS
7. Computer Vision - 12 Week 3 Credit Course, MOOCS
8. Applied Time-Series Analysis 12 Week 3 Credit Course, MOOCS
9. Parallel Computer Architecture 12 Week 3 Credit Course, MOOCS
10. Reinforcement Learning 12 Week 3 Credit Course, MOOCS
11. GPU Architecture and Programming 12 Week 3 Credit Course, MOOCS
12. Computational Complexity 12 Week 3 Credit Course, MOOCS
13. Quantum Algorithms and Cryptography 12 Week 3 Credit Course, MOOCS
14. Unmanned Arial Systems & Robotics 12 Week 3 Credit Course, MOOCS
15. Prompt Engineering for Generative AI (III - II)

1. Computer Networks 3-0-0-3
2. Artificial Intelligence 3-0-0-3
3. Cyber Security 3-0-0-3
4. Introduction to Data Science 3-0-3-4.5
5. Data Warehousing and Data Mining 3-0-0-3
6. Object Oriented Programming Through Java 3-0-3-4.5
7. Cloud computing 3-0-0-3
8. Graph Theory 3-0-0-3
9. Data Analytics with Python
10. Foundations of Cryptography

HONOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING

(I) Computer Networks

S.No	Subject Title	L	T	P	C
1	Data Communication	3	1	0	4
2	Internetworking with TCP/IP	3	1	0	4
3	Network Programming	3	0	2	4
4	Wireless Network Technologies	3	1	0	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(II) Cyber Security

S.No	Subject Title	L	T	P	C
1	Cyber Security Essentials	3	1	0	4
2	Secure Coding	3	0	2	4
3	Vulnerability Assessment & Penetration Testing	3	1	0	4
4	Malware Analysis	3	0	2	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(III) Pattern Recognition

S.No	Subject Title	L	T	P	C
1	Digital Image Processing	3	1	0	4
2	Biometrics	3	1	0	4
3	Speech Processing	3	1	0	4
4	Advanced Computer Vision	3	1	0	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(IV) Data Science

S.No	Subject Title	L	T	P	C
1	Mathematical Essential for Data Science	3	1	0	4
2	Introduction to Data Science	3	1	0	4
3	Data Analytics and Visualization	3	1	0	4
4	Python for Data Science	3	0	2	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

MINOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING

(For non CSE/IT Students)

Minor Degree in Computer Science and Engineering

S.No	Subject Title	L	T	P	C
1	Data Structures	3	1	0	4
2	Database Management Systems	3	1	0	4
3	Operating Systems	3	1	0	4
4	Computer Networks	3	1	0	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(I) Artificial Intelligence

S.No	Subject Title	L	T	P	C
1	Introduction to Artificial Intelligence	3	1	0	4
2	Mathematics for Machine Learning	3	1	0	4
3	Machine Learning	3	1	0	4
4	Deep Learning	3	1	0	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(II) Computer Security

S.No	Subject Title	L	T	P	C
1	Cyber Security	3	1	0	4
2	Cyber Crime Investigation and Digital Forensics	3	1	0	4
3	Cryptography and Applications	3	1	0	4
5	Blockchain Technology	3	1	0	4
6	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(III) Programming and Web Development

S.No	Subject Title	L	T	P	C
1	Object Oriented Programming through Java	3	0	2	4
2	Python Programming	3	0	2	4
3	Basic Web Designing	3	0	2	4
4	Advanced Web Technologies	3	0	2	4
5	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

(IV) Advanced Computing

S.No	Subject Title	L	T	P	C
1	Computer Organization and Architecture	3	1	0	4
2	Client Server Computing	3	1	0	4
4	Distributed Systems	3	1	0	4
5	Cloud Computing	3	1	0	4
6	02 MOOCS courses @ 2credits each (Any CSE/IT related**Program Core subject** from NPTEL/ SWAYAM course of 8 weeks (2 credits) other than the courses listed above needs to be taken)				4
				Total	20

III Year I Semester	DATA WAREHOUSING & DATA MINING	L	T	P	C
		3	0	0	3

Course Objectives:

Students undergoing this course are expected to:

i. Understand the concepts of Data Ware housing and DataMining
ii. Understand various data mining functionalities and Extract knowledge using data mining techniques
iii. Characterize the kinds of patterns that can be discovered by classification, clustering and association rulemining.
iv. Master data mining techniques in various applications like social, scientific and environmentalcontext.
v. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

UNIT –I: Data Mining Systems and Knowledge Discovery Process:

Data Warehouse and OLAP Technology: An Overview- What Is a Data Warehouse. A Multidimensional Data Model - Need for Online Analytical Processing - OLTP V/s OLAP -OLAP Operations in Multidimensional Data Model. Data Warehouse Architecture, Data Warehouse Implementation, From Data Warehousing to Data Mining.

Need and Usage of Data Mining Technologies - Overview of Knowledge Discovery Process from Databases–What Motivated Data Mining - Why Is It Important - Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Are All of the Patterns Interesting Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major Issues in DataMining.

UNIT–II: Data Pre-processing:

Data Exploration: Data Objects and attribute types -Statistical description of data- Descriptive Data Summarization-Data Visualization - Data similarity and dissimilarity measures.

Data Pre-processing: Why Pre-process the Data -Data Cleaning-Data Integration-Data Reduction- Data Transformation and Data Discretization.

UNIT–III: Classification:

Basic issues regarding classification and predication - General Approach to solving a classification problem- Decision Tree Classification, Attribute Selection Measures, Tree Pruning-Bayesian Classification – Rule Based Classification – Support Vector Machines.

Classification Model Evaluation and Selection - Accuracy and Error measures, Holdout, Random Sampling, Cross Validation, Bootstrap, Comparing Classifier performance using ROC Curves.

UNIT–IV: Mining Frequent Patterns and Association Rules:

Basic Concepts-Problem Definition- Market Basket Analysis- Frequent Itemsets- Closed Itemsets and Association Rules - Frequent Pattern Mining - Efficient and Scalable Frequent Itemset Mining Methods- the Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation - Generating Association Rules from Frequent Itemsets - A pattern growth approach for mining Frequent Itemsets- FP-Growth Algorithm

UNIT V: Cluster Analysis:

Basics and Importance of Cluster Analysis- Clustering techniques- Different Types of Clusters- Partitioning Methods (K-Means, K Medoids) -Strengths and Weaknesses. Hierarchical Methods (Agglomerative, Divisive) - Density-Based Methods (DBSCAN, OPTICS)-

Course Outcomes:

After completion of the course, students should be able to:

i. Understand Data Warehouse fundamentals, Data Mining concepts, principles and its functionalities
ii. Pre process the data using various Data Pre processing Techniques for miningapplications
iii. Design and deploy appropriate classification techniques to solve real world problems and further be able to assess the strengths and weaknesses of various methods and algorithms to analyze theirbehavior.
iv. Demonstrate Association analysis techniques for generating association rules fromdata.
v. Use different Clustering techniques to cluster data and Cluster the high dimensional data for better organization of thedata

Text Books:

i. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar,Pearson.
ii. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

References:

i. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
ii. Data Mining :VikramPudi and P. Radha Krishna,Oxford.
iii. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J.Zaki, Wagner Meira, Jr, Oxford
iv. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith,TMH.

E-resources:

i. http://onlinecourses.nptel.ac.in/noc18_cs14/preview (NPTEL course by Prof.Pabitra Mitra)
ii. http://onlinecourses.nptel.ac.in/noc17_mg24/preview
(NPTEL course by Dr. Nandan Sudarshanam & Dr. Balaraman Ravindran)
iii. http://www.saedsayad.com/data_mining_map.htm

III Year I Semester	COMPILER DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the
i. The phases of acompiler
ii. Design of lexical analyzers, Syntax analyzers, Intermediate codegenerators
iii. Usage of Lex/Bison tools in writingcompilers
iv. Different optimizations and analyses required to do thoseoptimizations
v. Issues in the code generation, code generation generationalgorithms

UNIT - I:
Introduction and Lexical Analysis

Language Processors, the structure of a compiler, the science of building a compiler, phases of a compiler. Lexical Analysis: The role of the lexical analyzer, Identifying tokens, Transition diagrams for recognizing tokens, Input buffering, The lexical analyzer generator Lex, Finite automata, Conversion from regular expressions to automata, design of a lexical analyzer generator, Optimization of DFA-based patternmatchers.

UNIT - II:
Syntax Analysis

Introduction, Context-Free Grammars, BNF(Backus-Naur Form), EBNF(Extended Backus-Naur Form). Preprocessing of grammars: left recursion elimination, left factoring. Top-Down Parsing: Recursive-descent parsers, LL(1) parsers. Bottom-Up parsing: Introduction to LR parsers, Simple LR, Canonical LR, Lookahead LR. Extending parsers to handle ambiguous grammars, Parser generators Yacc/Bison.

UNIT – III:
Syntax-Directed Translation, Semantic Analysis, Intermediate Code Generation

Syntax-Directed Definitions, Evaluation orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, and Implementing L-Attributed SDD's.
Intermediate code generation: Variants of Syntax trees, Three-address code, Types and declarations, Type checking, Control flow, Back patching, Switch-Statements, Intermediate Code for Procedures.

UNIT - IV:
Code Optimization, Run-time Environment

Run-Time Environments: Storage organization, Activation record, Stack allocation, Access to nonlocal data on the stack, Heap management, Introduction to garbage collection, Introduction to trace-based collection. Machine-Independent optimizations: The principal sources of optimization, Basic blocks and flow graphs, Introduction to data-flow analysis, Foundations of data-flow analysis, Constant propagation.

UNIT - V: Target Code Generation

Code Generation: Issues in the design of a Code Generator, The target language, Addresses in the target code, A simple code generator.

Machine-dependent Optimizations: Peephole optimization, Register allocation and assignment, Dynamic Programming code generation.

Course Outcomes:

The students should be able to:

i. Understand the basics of language processing and implement lexical analyzer for any language.
ii. Understand the different types of parsing and implement parser for any language.
iii. Understand the different intermediate code representations and use Syntax directed definitions to design a intermediate code generators for any language construct.
iv. Understand the basics of data flow analysis, optimizations, and run time environment required for handling recursive procedures.
v. Understand the issues in the code generation and code generation algorithms.

Text Books:

i. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman,Pearson.
ii. Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.

Reference Books:

i. Modern Compiler Implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
ii. The Theory and Practice of Compiler writing, J. P. Tremblay and P. G. Sorenson,TMH
iii. lex & yacc, 2nd Edition by John Levine, Doug Brown, Tony Mason

E-resources:

i. https://www.edx.org/course/compilers
ii. https://nptel.ac.in/courses/106/108/106108113/

III Year I Semester	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the
i. Analyze the asymptotic performance of algorithms
ii. Write rigorous correctness proofs for algorithms
iii. Demonstrate a familiarity with major algorithms and data structures
iv. Apply important algorithmic design paradigms and methods of analysis
v. Synthesize efficient algorithms in common engineering design situations

UNIT - I:

Introduction: What is an Algorithm, Algorithm Specification, Pseudo code Conventions Recursive Algorithm, Performance Analysis, Space Complexity, Time Complexity, Amortized Complexity, Amortized Complexity, Asymptotic Notation, Practical Complexities' Performance Measurement.

UNIT - II:

Decrease-and-Conquer: Insertion Sort Algorithms for Generating Combinatorial Objects Decrease-by-a-Constant-Factor Algorithms Variable-Size-Decrease Algorithms
Dived and Conquer: Merge Sort, Quick Sort, Multiplication of Large Integers and Strassen's Matrix Multiplication
Transform and conquer: Pre-sorting Balanced Search Trees, Heaps and Heap sort

UNIT - III:

The Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines Minimum-cost Spanning Trees, Prim's Algorithm, Kruskal's Algorithms, An Optimal Randomized Algorithm, Optimal Merge Patterns, Single Source Shortest Paths.

UNIT - IV:

Dynamic Programming: The General Method Multistage graph ,All - Pairs Shortest Paths, , String Edition, 0/1 Knapsack, Reliability Design, optimal binary search trees.

UNIT - V:

Backtracking: The General Method, The S-Queens Problem, Sum of Subsets, Graph Coloring Hamiltonian Cycles
Branch and Bound: The Method, Least cost (LC) Search, The 15-Puzzle: an Example, Control Abstraction for LC-Search, Bounding, FIFO Branch-and-Bound, LC Branch and Bound, 0/1 Knapsack problem, LC Branch-and Bound Solution, FIFO Branch-and-Bound Solution, Traveling Salesperson problem.

Course Outcomes:

The students should be able to:

i. Argue the correctness of algorithms using inductive proofs and invariants, Analyze worst-case running times of algorithms testing asymptotic analysis.
ii. Describe the divide-and-conquer paradigm and explain when an algorithmic design. situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
iii. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ these paradigm Synthesize greedy algorithms and analyze them.
iv. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic programming algorithms, and analyze them.
v. Describe the Backtracking and branch and bound paradigms and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize Backtracking and branch and bound algorithms, and analyse them

Text Books:

i. Fundamentals of computer algorithms E. Horowitz S. Sahni, UniversityPress
ii. Introduction to the design and analysis of Algorithms Anany Levitin pearson ,3rd edition
iii. Introduction to Algorithms Thomas H Cormen PHILearning

Reference Books:

i. The Design and Analysis of Computer Algorithms,AlfredV AhoJohnE Hopcroft Jeffrey DUllman
ii. Algorithm Design, Jon Kleinberg,Pearson
iii. Algorithms, by Dasgupta, Papadimitrou and Vazirani, McGraw-Hill Education, 2006.

III Year I Semester	OBJECT ORIENTED ANALYSIS AND DESIGN (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives: The main objective is the students to

- Become familiar with all phases of OOAD.
- Master the main features of the UML.
- Master the main concepts of Object Technologies and how to apply them at work and develop the ability to analyze and solve challenging problem in various domains.
- Learn the Object design Principles and understand how to apply them towards Implementation.

UNIT I:

Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. **Case Study:** System Architecture: Satellite-Based Navigation

UNIT II:

Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. **Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. **Case Study:** Control System: Traffic Management.

UNIT III:

Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams. **Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. **Case Study:** AI: Cryptanalysis.

UNIT IV:

Basic Behavioral Modeling-I: Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. **Case Study:** Web Application: Vacation Tracking System

UNIT V:

Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams. **Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams. **Case Study:** Weather Forecasting

Text Books:

i. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston , “Object- Oriented Analysis and Design with Applications”, 3rd edition, 2013, PEARSON.
ii. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.

Reference Books:

i. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
ii. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd.
iii. AtulKahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.
iv. Appling UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.

III Year I Semester	SOFTWARE TESTING METHODOLOGIES (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. Describe the principles and procedures for designing test cases.

ii. Provide supports to debugging methods.

iii. Acts as the reference for software testing techniques and strategies.

UNIT-I:

Introduction: Purpose of Testing, Dichotomies, Model for Testing, Consequences of Bugs, Taxonomy of Bugs. FLOW GRAPHS AND PATH TESTING: Basics Concepts of Path Testing, Predicates, Path Predicates and Achievable Paths, Path Sensitizing, Path Instrumentation, Application of Path Testing.

UNIT-II:

Transaction Flows Testing: Transaction Flows, Transaction Flow Testing Techniques.

Dataflow Testing: Basics of Dataflow Testing, Strategies in Dataflow Testing, Application of Dataflow Testing.

Domain Testing: Domains and Paths, Nice & Ugly Domains, Domain testing, Domains and Interfaces Testing, Domain and Interface Testing, Domains and Testability.

UNIT-III:

Paths, Path Products and Regular Expressions:

Path Products & Path Expression, Reduction Procedure, Applications, Regular Expressions & Flow Anomaly Detection.

Syntax Testing: Why, What and How, A Grammar for formats, Test Case Generation, Implementation and Application and Testability Tips.

Based Testing: Overview, Decision Tables, Path Expressions, KV Charts, and Specifications.

UNIT-IV:

State, State Graphs And Transition Testing: State Graphs, Good & Bad State Graphs, State Testing, and Testability Tips.

Graph Matrices and Application:

Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm.

UNIT-V:

Software Testing Tools: Introduction to Testing, Automated Testing, Concepts of Test Automation, Introduction to list of tools like Win runner, Load Runner, Jmeter, Selenium About Win Runner ,Using Win runner, Mapping the GUI, Recording Test, Working with Test, Enhancing Test, Checkpoints, Test Script Language, Putting it all together, Running and Debugging Tests, Analyzing Results, Batch Tests, Rapid Test Script Wizard.

Course Outcomes:

The students should be able to:

i. Define Software testing terminology and methodology
ii. Discuss and Classify various testing techniques for conducting different types of software testing
iii. Apply different software testing techniques.
iv. Construct test cases by understanding test suite management and software quality management.
v. Demonstrate modern software testing tools and testing of Object Oriented Software and Web based software

Text Books:

i. Software testing techniques – Boris Beizer, Dreamtech, second edition.
ii. Software Testing- Yogesh Singh, Cambridge

Reference Books:

i. The Craft of software testing - Brian Marick, Pearson Education.
ii. Software Testing, 3rd edition, P.C. Jorgensen, Aurbach Publications (Dist.by SPD).
iii. Software Testing, N.Chauhan, Oxford University Press.
iv. Introduction to Software Testing, P.Ammann&J.Offutt, Cambridge Univ.Press.
v. Effective methods of Software Testing, Perry, John Wiley, 2nd Edition, 1999.
vi. Software Testing Concepts and Tools, P.NageswaraRao, dreamtech Press
vii. Win Runner in simple steps by Hakeem Shittu, Genixpress, 2007.
viii. Foundations of Software Testing, D.Graham& Others, Cengage Learning.

III Year I Semester	MICROPROCESSORS & MICROCONTROLLERS (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives:

i. To introduce fundamental architectural concepts of microprocessors and microcontrollers.
ii. To impart knowledge on addressing modes and instruction set of 8086 and 8051
iii. To introduce assembly language programming concepts
iv. To explain memory and I/O interfacing with 8086 and 8051
v. To introduce16 bit and 32 bit microcontrollers.

UNIT I:

8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

UNIT II:

8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT III:

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

UNIT IV:

Microcontroller, Architecture of 8051, Special Function Registers(SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

UNIT V:

Interfacing Microcontroller, Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation, Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Textbooks:

i. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition,1994.
ii. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.

iii. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

Reference Books:

i. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.
ii. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.

III Year I Semester	COMPUTER ARCHITECTURE (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives:

i. To understand the concept of Parallel Processing and itsapplications.
ii. Implement the Hardware for ArithmeticOperations.
iii. Analyze the performance of different scalar Computers.
iv. To learn the Pipelining Concept for a given set of Instructions.
v. Distinguish the performance of pipelining and non-pipelining environment in a processor.

UNIT -I:

Fundamentals of Computer Design: Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law. **Instruction Set Principles and Examples**: Introduction, Classifying instruction set- Memory addressing- type and size of operands, Operations in the instructionset.

UNIT –II:

Pipelines: Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties. **Memory Hierarchy Design**: Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtualmemory.

UNIT -III:

Instruction Level Parallelism the Hardware Approach: Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- Hardware basedspeculation.

UNIT -IV:

ILP Software: Approach Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues - Hardware verses Software. **The Processor:** Introduction, Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme, An Overview of Pipelining, Pipelined Datapath and Control, **Data Hazards:** Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions, The ARM Cortex-A8 and Intel Core i7 Pipelines.

UNIT –V:

Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization, **Inter Connection and Networks:** Introduction, Interconnection network media, Practical issues in interconnecting networks, Static and Dynamic Networks, Linear Array, Ring, Star, Tree, Mesh, Systolic Array, Chordal ring, Completely connected network, Cube connected cycles, Torus, K-ary-n cube, Barrel shifter, Single stage interconnection network, Multistage Interconnection Networks, Control Structure, Node degree, Diameter, Bisection width, Symmetric, Functionality, Network Latency, Bandwidth, Scalability, Cluster, Designing of clusters.

Intel Architecture: Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

Course Outcomes:

After the completion of the course, student will be able to

i. Understand the types of computers, and new trends and developments in computer architecture.
ii. Develop pipelining, instruction set architectures, memory addressing.
iii. Apply ILP using dynamic scheduling, multiple issue, and speculation.
iv. Analyze the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.
v. Determine the importance of multithreading by using ILP and supporting thread-level parallelism (TLP).

Text Books:

i. Computer Organization and Design: The hardware and Software Interface, David A Patterson, John L Hennessy, 5th edition, MK.
ii. Computer Architecture and Parallel Processing – Kai Hwang, Faye A.Brigs, McGraw Hill.
iii. John L. Hennessy, David A. Patterson – Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier.

Reference Books:

i. Modern Processor Design: Fundamentals of Super Scalar Processors, John P. Shen and Miikko H. Lipasti, Mc GrawHill.
ii. Advanced Computer Architecture – A Design Space Approach – Dezso Sima, Terence Fountain, Peter Kacsuk ,Pearson.
iii. Computer Architecture and Parallel Processing – Kai Hwang, Faye A.Brigs., MC Graw Hill.
iv. Introduction to Parallel Computing, 2nd Edition, Pearson Education by Ananth Grama, Anshul Gupta, George Karypis, VipinKumar.

E-Resources:

i. https://nptel.ac.in/courses/106/105/106105163/

III Year I Semester	COMPUTER GRAPHICS	L	T	P	C
		0	0	3	1.5

Course Objectives:

i. To develop, design and implement two and three dimensional graphicalstructures
ii. To learn Creation, Management and Transmission of Multimedia objects.

UNIT-I:

Introduction to Graphics: Application areas of Computer Graphics, overview of graphics systems, video-display devices, graphics monitors and work stations and input devices.
2D Primitives: Output primitives-Line, Circle and Ellipse drawing algorithms, Attributes of output primitives, Two dimensional Geometric transformations, Two dimensional viewing Line, Polygon, Curve and Text clipping algorithms.

UNIT-II:
3D Concepts: Parallel and Perspective projections - Three dimensional object representations – Polygons, Curved lines, Splines, Quadric Surfaces, - Visualization of data sets - 3D transformations – Viewing -Visible surface identification.

UNIT-III:
Illumination and Shading: Background, simple lighting model, shading models, intensity representation, color models, texture synthesis

UNIT-IV:
Graphics Hardware and Software:

Graphics programming using OPENGL-Basic graphics primitives, Drawing three dimensional objects, Drawing three dimensional scenes.
Rendering: Introduction to shading models, Flat and Smooth shading, Adding texture to faces, Adding shadows of objects, Building a camera in a program, Creating shaded objects.

UNIT V:
Fractals: Fractals and Self similarity, Peano curves, Creating image by iterated functions, Mandelbrot sets, Julia Sets, Random Fractals
Overview of Ray Tracing: Intersecting rays with other primitives, Adding Surface texture, Reflections and Transparency, Boolean operations on Objects.

Course Outcomes:

i. To learned various algorithms for drawing objects in 2D transformations like line, circle and ellipse.
ii. Apply projections and visible surface detection techniques for display of 3D scene on 2D screen.
iii. Able to select particular color model for lighting and shading ofobjects.
iv. To get an idea about the structure of OPENGL graphic software.
v. Able to create image using fractals and iteratedfunctions

Text Books:

i. Donald Hearn, Pauline Baker, Computer Graphics – C Version, PearsonEducation.
ii. F.S. Hill, Computer Graphics using OPENGL, PearsonEducation.

Reference Books:

i. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics Principles and practice in C, Pearson Education.

III Year I Semester	DATA MINING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

i. Practical exposure on implementation of well known data mining tasks and their effective use in discovering interesting hidden patterns from large datasets.

ii . Exposure to real time data sets for analysis and prediction.

iii. Focus is on the main process of data mining such as data preparation, classification, clustering, association analysis, and pattern evaluation

Software Requirements: WEKA Tool and R Programming/Python Programming

LIST OF EXPERIMENTS:

1. Study of WEKA tool and applying data mining techniques on following data sets in ARFF or CSV file Format.
2. Implementation / Usage of WEKA for classification of datasets suchas customer's data, weather forecasting data, agricultural dataetc.
3. Experiment to summarize and visualization of variousdatasets.
4. Experiment to demonstrate various data pre-processingtechniques
5. Experiment to select prominent feature subsets of variousdatasets.
6. Experiment to Evaluate Information Gain of an attribute in the studentdatabase
7. Demonstration of classification rule process using j48 decision treealgorithm
8. Demonstration of classification rule process using ID3 decision treealgorithm
9. Experiment to predict the class using the Bayesianclassification
10. Experiment to predict the class using the k-Nearest Neighbourclassification
11. Experiment to implement weight & bias updating using the BackPropagation NeuralNetwork
12. Demonstration of clustering process using k-meansalgorithm
13. Demonstration of mining frequent patterns using Apriorialgorithm
14. Demonstration of mining frequent patterns using FP-Growthalgorithm
15. Experiment to compare the performance of various data miningalgorithms on the give database.

Course Outcomes: After undergoing the course students will be able to:

i. Create summary statistics for the given datasets.
ii. Analyze various datasets and perform Data Pre-processing.
iii. Apply various data mining algorithms on the give data set to select the appropriate one.
iv. Develop skills and apply data mining tools for solving practical problems.
v. Handling a small data mining project for a given practical domain.

III Year I Semester	COMPILER DESIGN LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. Implementation of a compiler for a basic language
ii. Lex/Yacc specifications for designing frontend of a compiler
iii. MIPS instruction set

List of experiments

1. Check the ouput of different compilers gcc, g++, clang, clang++, javac, python etc by running respective language programs with different flags. (purpose to undetstand preprocessor, optimizations,linker)

2. The Language called TinyCStr is described asfollows

a) EveryTinyCStr program has one or more functions and syntax of function declaration and function definition is similar to C, one function function must be main.
b) Every TinyCStr function has zero or statements
c) The possible statements are declaration, assignment, conditional statements (if,else, for, while) except switch.
d) TinyCStr supports primitive data types of C and a string datatype

i. Implement a lexical analyser for TinyCStr usingflex/lex
ii. Implement a parser for TinyCStr using bison/yacc and generate AST(Abstract SyntaxTree)
iii. Generate a 3-address code from theAST
iv. Generate MIPS instructions from 3-address code and run it on SPIMsimulator

3. Write a program illustrating code optimizationtechniques:

i)Constantfolding ii) Copy propagation iii) Common subexpressionelimination
iv)Loop unrolling v) Dead codeelimination

Course Outcomes:

The students should be able to:

i. Understand the different phases of compilation and the working of compilers like gcc, clangetc
ii. Implement lexical analyzer for anylanguage
iii. Implement parser for anylanguage
iv. Implement 3-address code generator for simple programmingconstructs
v. Implement MIPS code generator by considering simple programmingconstructs

Text Books:

i. flex & bison by John Levine Released August 2009 Publisher(s): O'Reilly Media,Inc.
ii. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman,Pearson.

Reference Books:

i. LLVM Cookbook, Mayur pandey

E-resources:

i. https://llvm.org/
ii. https://gcc.gnu.org/
iii. https://www.dsi.unive.it/~gasparetto/materials/MIPS_Instruction_Set.pdf

III Year I Semester	FULL STACK DEVELOPMENT - 2 (SKILL ENHANCEMENT COURSE)	L	T	P	C
		0	1	2	2

Course Objectives:

The main objectives of the course are to

- Make use of router, template engine and authentication using sessions to develop application in ExpressJS.
- Build a single page application using RESTful APIs in ExpressJS
- Apply router and hooksin designing ReactJS application
- Make use of MongoDB queries to perform CRUD operations on document database

Experiments covering the Topics:

- ExpressJS – Routing, HTTP Methods, Middleware, Templating, Form Data
- ExpressJS – Cookies, Sessions, Authentication, Database, RESTful APIs
- ReactJS – Render HTML, JSX, Components – function & Class, Props and States, Styles, Respond to Events
- ReactJS – Conditional Rendering, Rendering Lists, React Forms, React Router, Updating the Screen
- ReactJS – Hooks, Sharing data between Components, Applications – To-do list and Quiz
- MongoDB – Installation, Configuration, CRUD operations, Databases, Collections and Records

Sample Experiments:

1. ExpressJS – Routing, HTTP Methods, Middleware.

a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
b. Write a program to accept data, retrieve data and delete a specified resource using http methods.
c. Write a program to show the working of middleware.

2. ExpressJS – Templating, Form Data

a. Write a program using templating engine.
b. Write a program to work with form data.

3. ExpressJS – Cookies, Sessions, Authentication

a. Write a program for session management using cookies and sessions.
b. Write a program for user authentication.

4. ExpressJS – Database, RESTful APIs

a. Write a program to connect MongoDB database using Mangoose and perform CRUD operations.
b. Write a program to develop a single page application using RESTful APIs.

5. ReactJS – Render HTML, JSX, Components – function & Class

a. Write a program to render HTML to a web page.
b. Write a program for writing markup with JSX.
c. Write a program for creating and nesting components (function and class).

6. ReactJS – Props and States, Styles, Respond to Events

a. Write a program to work with props and states.
b. Write a program to add styles (CSS & Sass Styling) and display data.
c. Write a program for responding to events.

7. ReactJS – Conditional Rendering, Rendering Lists, React Forms

a. Write a program for conditional rendering.
b. Write a program for rendering lists.
c. Write a program for working with different form fields using react forms.

8. ReactJS – React Router, Updating the Screen

a. Write a program for routing to different pages using react router.
b. Write a program for updating the screen.

9. ReactJS – Hooks, Sharing data between Components

a. Write a program to understand the importance of using hooks.
b. Write a program for sharing data between components.

10. MongoDB – Installation, Configuration, CRUD operations

a. Install MongoDB and configure ATLAS
b. Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

11. MongoDB – Databases, Collections and Records

a. Write MongoDB queries to Create and drop databases and collections.
b. Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().

12. Augmented Programs: (Any 2 must be completed)

a. Design a to-do list application using NodeJS and ExpressJS.
b. Design a Quiz app using ReactJS.
c. Complete the MongoDB certification from MongoDB University website.

Text Books:

i. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.
ii. Node.Js in Action, Mike Cantelon, Mark Harter, T.J. Holowaychuk, Nathan Rajlich,Manning Publications. (Chapters 1-11)

iii. React Quickly, AzatMardan,Manning Publications(Chapters 1-8,12-14)

Web Links:

i. ExpressJS - https://www.tutorialspoint.com/expressjs
ii. ReactJS - https://www.w3schools.com/REACT (and) https://react.dev/learn#
iii. MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb

III Year II Semester	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

i. To introduce the fundamental various types of computernetworks.
ii. To understand state-of-the-art in network protocols, architectures, andapplications.
iii. To explore the various layers of OSIModel.
iv. To introduce UDP and TCPModels.

UNIT-I:
Introduction: Network Hardware and softwareReference models- The OSI Reference Model-the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.
Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous time division multiplexing, statistical time division multiplexing.

UNIT-II:
The Data Link Layer - Design Issues, Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols, Sliding WindowProtocols.
Channel allocation methods: TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision Free protocols – IEEE standard 802 for LANS – Ethernet, Token Bus, Token ring, Bridges and IEEE 802.11 and 802.16. Data link layer switching, virtualLANs.

UNIT-III:
Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding, Flow based Distance vector, Link state, Hierarchical, Broadcast routing, Congestion Control algorithms-General principles of congestion control, Congestion prevention polices, Choke packets, Load shedding, and Jitter Control.
Internet Working : Tunnelling, internetworking, Fragmentation, Network layer in the internet

– IP protocols, IP address, Subnets, Internet control protocols, OSPF, BGP, Internet multicasting, Mobile IP, IPV6.

UNIT IV:
The Transport Layer: Elements of transport protocols – addressing, establishing a connection, releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP, Real Time Tran sport Protocol.
The Internet Transport Protocol: TCP- reliable Byte Stream (TCP) end to end format, segment format, connection establishment and termination, sliding window revisited, adaptive retransmission, TCP extension, Remote Procedure Call.

UNIT – V:
Application Layer: WWW and HTTP: Architecture- Client (Browser), Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication**,** HTTP Generic Message Format, HTTP Request Message Format, HTTP

Response Message Format.

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery.

Course Outcomes:

The students are able to

i. Understand OSI and TCP/IP reference models with an emphasis to Physical Layer, Data Link Layer and Network Layer.
ii. Analyze the issues related to data link, medium access and transport layers by using channel allocation and connection management schemes. Analyze MAC layer protocols and LAN technologies.
iii. Solve problems related to Flow control, Error control, Congestion control and Network Routing.
iv. Design and compute subnet masks and addresses for networking requirements.
v. Understand how internet works,

Text Books:

i. Data Communications and Networks – Behrouz A. Forouzan, Third EditionTMH.
ii. Computer Networks, 5ed, David Patterson,Elsevier
iii. Computer Networks: Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
iv. Computer Networks, Mayank Dave, CENGAGE

References:

i. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
ii. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education
iii. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, PearsonEducation
iv. Understanding communications and Networks, 3rd Edition, W.A. Shay, ThomsonThe TCP/IP Guide, by Charles M. Kozierok, Free online Resource,http://www.tcpipguide.com/free/index.htm

III Year II Semester	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objectives:

i. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in thatlanguage
ii. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AIprograms
iii. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, andplanning

UNIT- I:

Introduction: history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends.

UNIT -II:

Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening A*, constraintsatisfaction.

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha beta pruning, two-player perfect informationgames.

UNIT –III:

Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

UNIT -IV:

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, CYC theory, case grammars, semantic web

UNIT–V:

Expert system and applications: Introduction phases in building expert systems, expert system versus traditional systems Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory ,Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Course Outcomes:

i. Outline problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
ii. Apply the language/framework of different AI methods for a given problem
iii. Implement basic AI algorithms- standard search algorithms or dynamic programming
iv. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports
v. Design Expert Systems using fuzzy logic theory

Text Books:

i. Artificial Intelligence- Saroj Kaushik, CENGAGELearning
ii. Artificial intelligence, A modern Approach , 2nded, Stuart Russel, Peter Norvig,PEA

Reference Books:

i. Artificial Intelligence- Deepak Khemani, TMH,2013
ii. Introduction to Artificial Intelligence, Patterson,PHI
iii. Atificial intelligence, structures and Strategies for Complex problem solving,-George F Lugar, 5thed, PEA

e-Resources:

i. https://nptel.ac.in/courses/106/105/106105077/
ii. ii.http://aima.cs.berkeley.edu/

III Year II Semester	CRYPTOGRAPHY & NETWORK SECURITY	L	T	P	C
		3	0	0	3

Course Objective:

This course aims at training students to master the:

i. The concepts of classical encryption techniques and concepts of finite fields and number theory
ii. Working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
iii. Design issues and working principles of various authentication protocols and PKI standards
iv. Various secure communication standards including Kerberos, IPsec, SSL/TLS, S/MIME and PGP

UNIT- I:

Introduction to Security: Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, a Model for Network Security

Mathematics of Cryptography: Algebraic Structures (Groups, Rings, Fields and Galois Fields), Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms

UNIT- II:

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography

Block Ciphers: Traditional Block Cipher Structure, The Data Encryption Standard, The Strength of DES, Block Cipher Design Principles, Advanced Encryption Standard, AES Structure, AES Transformation Functions, AES Key Expansion, Multiple Encryption and Triple DES, Block Cipher Modes of Operation

UNIT- III:

Public-Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Cryptography

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA)

Message Authentication Codes: Requirements for Message Authentication Codes, HMAC, CMAC

UNIT- IV:

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure

User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption:

UNIT -V:

Transport-Level Security: Web Security Considerations, Transport Layer Security, Secure Shell (SSH)

Electronic Mail Security: S/MIME, Pretty Good Privacy

IP Security: IP Security Overview, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

i. Identify information security goals and acquire fundamental knowledge on the concepts of finite fields and number theory
ii. Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
iii. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
iv. Apply different digital signature algorithms to achieve authentication and create secure applications
v. Apply network security basics, analyze different attacks on networks and evaluate the performance of security protocols like SSL, IPSec, and PGP

Text Book:

i. Cryptography and Network Security, William Stallings, 8th Edition, Pearson Education

Reference Books:

i. Cryptography, Network Security and Cyber Laws, Bernard L. Menezes, Ravinder Kumar, Cengage Learning.
ii. Cryptography and Network Security, Behrouz A Forouzan, Debdeep

Mukhopadhyaya, 3rd Edition, Mc-GrawHill.
iii. Network Security Illustrated, Jason Albanese, Wes Sonnenreich, McGraw Hill.

E-Resources:

i. https://nptel.ac.in/courses/106/105/106105031/ lecture by Dr.Debdeep Mukhopadhyay IIT Kharagpur [Video Lecture]
ii. https://nptel.ac.in/courses/106/105/106105162/ lecture by Dr. Sourav Mukhopadhyay IIT Kharagpur [Video Lecture]
iii. https://www.mitel.com/articles/web-communication-cryptography-and-network-security web articles by Mitel Power Connections

III Year II Semester	CLOUD COMPUTING (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objective:

i. To understand the concept of cloud computing.
ii. To appreciate the evolution of cloud from the existing technologies.
iii. To have knowledge on the various issues in cloud computing.
iv. To be familiar with the lead players in cloud.
v. To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT-I:

Introduction: Introduction to Cloud Computing, Definition of Cloud, Evolution of Cloud Computing, Underlying Principles of Parallel and Distributed Computing, Cloud Characteristics, Elasticity in Cloud – On-Demand Provisioning.

UNIT-II:

Cloud Enabling Technologies: Service Oriented Architecture, REST and Systems of Systems, Web Services, Publish-Subscribe Model, Basics of Virtualization, Types of Virtualization, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtualization Support and Disaster Recovery.

UNIT-III:

Cloud Architecture, Services And Storage: Layered Cloud Architecture Design, NIST Cloud Computing Reference Architecture, Public, Private and Hybrid Clouds, laaS, PaaS, SaaS, Architectural Design Challenges, Cloud Storage, Storage-as-a-Service, Advantages of Cloud Storage, Cloud Storage Providers, S3.

UNIT-IV:

Resource Management And Security In Cloud: Inter Cloud Resource Management, Resource Provisioning and Resource Provisioning Methods, Global Exchange of Cloud Resources, Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards.

UNIT-V:

Cloud Technologies And Advancements: Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack, Federation in the Cloud, Four Levels of Federation, Federated Services and Applications, Future of Federation.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

i. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
ii. Learn the key and enabling technologies that help in the development of cloud.
iii. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
iv. Explain the core issues of cloud computing such as resource management and security.
v. Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

Text Book:

i. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, Morgan Kaufmann Publishers.
ii. Cloud Computing: Implementation, Management and Security, Rittinghouse, John W., and James F. Ransome, CRC Press.

Reference Books:

i. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Tata Mcgraw Hill.
ii. Cloud Computing - A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, Tata McGraw Hill.
iii. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), George Reese, O'Reilly.

III Year II Semester	CYBER SECURITY (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives:

The aim of the course is to

i. identify security risks and take preventive steps
ii. understand the forensics fundamentals
iii. understand the evidence capturing process
iv. understand the preservation of digital evidence

UNIT I: Introduction to Cybercrime: Introduction, Cyber crime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyber stalking, Cyber cafe and Cyber crimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

UNIT II: Tools and Methods : Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, VirusandWorms,TrojanHorsesandBackdoors,Steganography,Sniffers,Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

UNITIII: Cyber Crime Investigation: Introduction, Investigation Tools,eDiscovery,Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNITIV: Computer Forensics and Investigations: Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

UNIT V: Cyber Crime Legal Perspectives: Introduction, Cyber crime and the Legal Land scape around the World, The Indian ITAct, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian ITAct, Amendments to the Indian ITAct,Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

Text Books:

i. Sunit Belapure Nina Godbole “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, WILEY, 2011.
ii. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning,

New Delhi, 2009.

Reference Books:

i. Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hacking and Network Defence", Cengage, 2019.
ii. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
iii. Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar "Cyber Security and Cyber Laws" , Cengage,2018.

E-Resources:

i. CERT-In Guidelines- http://www.cert-in.org.in/
ii. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks [Online Course]
iii. https://computersecurity.stanford.edu/free-online-videos [Free Online Videos]
iv. NickolaiZeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu License:Creative CommonsBY-NC-SA.

III Year II Semester	DEVOPS (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives:

i. DevOps improves collaboration and productivity by automating infrastructure
ii. workflows and continuously measuring applications performance.

UNIT- I:

Phases of Software Development life cycle. Values and principles of agile software development.

UNIT –II:

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system.

UNIT –III:

DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.

UNIT –IV:

CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment , Benefits of CI/CD, Metrics to track CICD practices

UNIT -V:

Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity model, DevOps maturity Assessment

Course Outcomes:

At the end of the course, student will be able to

i. Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
ii. Describe DevOps & DevSecOps methodologies and their key concepts
iii. Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
iv. Set up complete private infrastructure using version control systems and CI/CD tools Know about DevOps maturity model.

III Year II Semester	NoSQL DATABASES (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives:

The objective of this course is to

i. Explore the emergence, requirements and benefits of a NoSQL database.

ii. Understand the basic architecture and data models of a NoSQL database (key-value stores, document databases, column-family stores, graph databases).

UNIT-I:

Introduction and Basic Concepts:

Overview, and History of NoSQL Databases, Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points, Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases.

UNIT-II:

NoSQL Key/Value databases using MongoDB:

Document Databases, What Is a Document Database? Features, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

UNIT-III:

Column- oriented NoSQL databases using Apache HBASE:

Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, What Is a Column-Family Data Store? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage, When Not to Use.

UNIT-IV:

NoSQL Key/Value databases using Riak:

Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets.

UNIT-V:

Graph NoSQL databases using Neo4:

NoSQL database development tools and programming languages, Graph Databases, What Is a Graph Database? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.

Course Outcomes:

On completion of this course, the students will be able to

i. Differentiate between various non-relational (NoSQL) database.
ii. Create Document oriented NoSQL databases using Mongo DB.
iii. Create Column- oriented NoSQL databases using Apache HBASE.
iv. Create NoSQL Key/Value databases using Riak.
v. Create Graph NoSQL databases using Neo4.

Text Books:

i. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence,Pramod J. Sadalage, Martin Fowler,Pearson Education, 2013.
ii. Shashank Tiwari. Professional NoSQL. John Wiley and Sons. ISBN: 978-0-470-94224-6.

Reference Books:

i. A Guide to Modern Databases and the NoSQL Movement Edition, Redmond, E. &Wilson
ii. Redmond, E. & Wilson, J. (2012). Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement (1st Ed.). Raleigh, NC: The Pragmatic Programmers, LLC.
iii. Dan Sullivan. NoSQL for Mere Mortals. Addison-Wesley Professional. 2015.
iv. Guy Harrison. Next-Generation Databases. Apress. 2016.

III Year II Semester	SOFTWARE PROJECT MANAGEMENT (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To study how to plan and manage projects at each stage of the software development life cycle (SDLC)
ii. To train software project managers and other individuals involved in software project planning and tracking and oversight in the implementation of the software project management process.
iii. To understand successful software projects that support organization's strategic goals.

UNIT-I:

Conventional Software Management: The Waterfall Model, Conventional Software Management Performance.

Evolution Of Software Economics: Software Economics, Pragmatic Software Cost Estimation.

Improving Software Economics: Reducing Software Product Size, Improving Software Processes, Improving Team Effectiveness, Improving Automation through Software Economics.

UNIT-II:

The Old Way and the New: The Principles of Conventional Software Engineering, The Principles of Modern Software Management, Transitioning to an Iterative Process.

Life Cycle Phases: Engineering and Production Stages, Inception Phase, Elaboration Phase, Construction Phase, Transition Phase.

UNIT-III:

Model Based Software Architectures: A Management Perspective, A Technical Perspective.

Workflows of the Process: Software Process Workflows, Iteration Workflows.

Iterative Process Planning: Work Breakdown Structures, Planning Guidelines, The Cost and Schedule Estimating Process, The Iteration Planning Process.

UNIT-IV:

Project Organization and Responsibilities: Line-Of-Business Organizations, Project Organizations, Evolution of Organizations.

Project Control and Process Instrumentation: The Seven Core Metrics,

Management Indicators, Quality Indicators Modern Project Profiles. The COCOMO Cost Estimation Model: COCOMO.

UNIT-V:

Effort Estimation and Scheduling: Effort Estimation, Scheduling.

Quality Planning: Quality Concepts, Quantitative Quality Management Planning. RISK MANAGEMENT: Risk Assessment, Risk Control.

Course Outcomes:

The students should be able to:

i. Estimate overall cost of a software project.
ii. Explain software development process.
iii. Distinguish workflows of process.
iv. Design project organization structure & analyze quality.
v. Estimate effort and schedule needed for project.

Textbooks:

i. Walker Royce, "Software Project Management – A UnifiedFramework", 1stEdition, Pearson Education, 2002.
ii. PankajJalote, "Software Project Management in Practice", 1stEdition, Pearson Education, 2005.
iii. Software Project Management, Bob Hughes & Mike Cotterell, TATA Mcgraw-Hill.

References:

i. Bob Hughes, "Mike Cotterell, Rajib Mall, Software Project Management", 5thEdition, McGraw-Hill Higher Education, 2011.
ii. Joel Henry, "Software Project Management", 1st Edition, Pearson Education, 2006.
iii. Norman E. Fenton,Shari Lawrence Pfleeger, "Software Metrics: A Rigorous and Practical Approach ", 1st Edition, PWS Publishing Company, 1997

III Year II Semester	NATURAL LANGUAGE PROCESSING (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

i. Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
ii. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
iii. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

UNIT I:

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II:

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III:

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT IV:

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V:

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

i. Speech and Language Processing: An Introduction to Natural Language Processing, Computational

Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.
ii. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

i. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
ii. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media,2015.
iii. Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
iv. Natural Language Processing and Information Retrieval, 3rd Edition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008.

III Year II Semester	BIG DATA ANALYTICS (Professional Elective-III)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. Necessisty of Big data analysis and challenges in Big data analysis
ii. Descriptive, Predictive, Rela time analysis of big data
iii. Programming tools PIG & HIVE in Hadoop echo system

UNIT - I: Introduction: Introduction to big data: Introduction to Big Data platform, Challenges of conventional systems, Intelligent data analysis, Nature of data, Analytic processes and tools, Analysis vs Reporting.

UNIT - II: Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies - Real Time Sentiment Analysis - Stock Market Predictions.

UNIT - III: Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

UNIT - IV: Frameworks and Applications: Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and ZooKeeper.

UNIT - V: Predictive Analytics and Visualizations: Predictive Analytics, Simple linear regression, Multiple linear regression, Interpretation of regression coefficients, Visualizations, Visual data analysis techniques, interaction techniques, Systems and application

Course Outcomes:

The students should be able to:

i. Understand and Illustrate characteristics of big data and big data challenges in different domains including social media, transportation, finance and medicine
ii. Demonstrate stream processing on real time applications
iii. Do Big data processing using Map reduce on Hadoop
iv. Do Big data processing using PIG scripts and HiveQL queries
v. Understand Predictive analysis of big data.

Text Books:

i. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'reilly Media, Fourth Edition, 2015.
ii. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
iii. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012

Reference Books:

i. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
ii. Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, "Harness the Power of Big Data:The IBM Big Data Platform", Tata McGraw Hill Publications, 2012.
iii. Arshdeep Bahga and Vijay Madisetti, "Big Data Science & Analytics: A Hands On Approach ", VPT, 2016.
iv. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons, 2014.

E-resources:

i. https://www.edx.org/course/big-data-fundamentals
ii. https://hadoop.apache.org/
iii. https://pig.apache.org/
iv. https://hive.apache.org/

III Year II Semester	DISTRIBUTED SYSTEM (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

i. To understand the foundations of distributed systems.
ii. To learn issues related to clock Synchronization, the need for global state and remote invocation in distributedsystems.
iii. To learn distributed mutual exclusion and deadlock detection algorithms.
iv. To learn the characteristics of peer-to-peer, distributed shared memory systems and security.
v. To understand the significance of agreement, distributed transactions, fault tolerance and recovery protocols in Distributed Systems.

UNIT- I:

Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges, Relation to Computer system Components, Motivation, Relation to Parallel Systems, Message-Passing systems versus Shared Memory systems, Primitives for Distributed Communication, Synchronous versus Asynchronous executions, Design issues and Challenges. **A model of Distributed Computations:** A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of Process Communications. **Logical Time:** A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.

UNIT –II:

Message Ordering and Group Communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order.

Global state and Snapshot Recording Algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels. **Remote Invocation:** Introduction, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection, Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI.

UNIT- III:

Distributed Mutual Exclusion Algorithms: Introduction, Preliminaries, Lamport's algorithm, Ricart-Agrawala algorithm, Maekawa's algorithm, Suzuki–Kasami's broadcast algorithm. **Deadlock Detection in Distributed Systems:** Introduction, System model, Preliminaries, Models of deadlocks, Knapp's Classification, Algorithms for the Single Resource Model, the AND model and the OR model.

UNIT -IV:

Peer-to-Peer Computing and Overlay Graphs: Introduction, Data indexing and overlays, Chord distributed hash table, Content addressable networks**,** Tapestry. **Distributed Shared Memory:** Abstraction and advantages, Memory consistency models, Shared Memory Mutual Exclusion.

Security: Introduction, Overview of Security Techniques, Cryptographic Algorithms, Digital Signatures, Cryptography Pragmatics.

UNIT –V:

Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions. **Check Pointing and Rollback Recovery:** Introduction, Background and definitions, Issues in Failure recovery, Checkpoint-based recovery, Log-based rollback recovery, coordinated check pointing algorithm, Algorithms for asynchronous and synchronous check pointing and recovery. **Consensus and Agreement Algorithms:** Problem definition, Overview of results, Agreement in a Failure-Free system (synchronous or asynchronous).

Course Outcomes:

At the end of the course, the students will be able to:

i. Understand the foundations and issues of distributed systems.
ii. Illustrate the various synchronization issues, global state and remote invocation for distributed systems.
iii. Develop the Mutual Exclusion and Deadlock detection algorithms in distributed systems.
iv. Apply the features of peer-to-peer, distributed shared memory systems and security.
v. Analyze the distributed transactions, agreement protocols and fault tolerance mechanisms in distributed systems.

Text Books:

i. Distributed computing: Principles, algorithms, and systems, Ajay D Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011.
ii. Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and TimKindberg, 5th Edition, Pearson Education, 2012.

Reference Books:

i. Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall ofIndia, 2007.
ii. Advanced concepts in operating systems. Mukesh Singhal and Niranjan G. Shivaratri,McGraw-Hill, 1994.
iii. Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M.,Pearson Education, 2007.

E-Resources:

i. https://nptel.ac.in/courses/106/106/106106168/

III Year II Semester	AI TOOLS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

This course is introduced to

i. Learn the fundamentals of most widely used Python packages NumPy, Pandas and Matpotlib, and then apply them to Data Analysis and Data Visualization projects.
ii. To introduce the fundamental techniques and principles of Neural Networks
iii. Teach students the leading trends and systems in natural language processing

List of Experiments:

1. **Numpy**: Illustrate the concepts multi-dimensional arrays and matrices, along with a large library of high-level mathematical functions to operate on these arrays using numpy

2. **Pandas:** Visualize New York Motor Vehicle Crash DataUsing Python, Pandas, andMatplotlib.

Datasets Details:

https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Case-Information-Three-Year-/e8ky-4vqe
https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Individual-Information-Three/ir4y-sesj
https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Violation-Information-Three-/abfj-y7uq
https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Vehicle-Information-Three-Ye/xe9x-a24f

3. **Tensor-Flow:**Learn simple data curation by creating a pickle with formatted datasets for training, development and testing in Tensor Flow and develop visualizations in tensor board.
4. Create convolutional neural networks in TensorFlow.
5. **Image recognition** (or image classification) : identifying images and categorizing them in one of several predefined distinct classes using neural network models.
6. **OpenCV:** Develop an online writing Whiteboard with minimal features for online classes
7. **Keras:**Recognize handwritten digits from MNIST using Keras
8. **Scikit-learn :**Write a Python program using Scikit-learn to split the iris dataset into 70% train data and 30% test data. Out of total 150 records, the training set will contain 120 records and the test set contains 30 of those records. Print both datasets
9. Design a perceptron classifier to classify handwritten numerical digits (0-9). Implement using scikit or Weka.
10. **NLP:** Program to illustrate the concepts sentence segmentation, word tokenization, stemming and lemmatization, Hidden markov model(HMM) for Parts of speech (PoS) Tagging

Course Outcomes: Upon the successful completion of this course, students will be able to

i. Apply the tools of AI in the field of Engineering.
ii. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
iii. design and implement solutions to classification, regression, and clustering problems
iv. Implement deep learning algorithms and solve real-world problems
v. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods

References:

i. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
ii. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
iii. Chris Albon : Machine Learning with Python Cookbook , O"Reilly Media, Inc.2018

Web Resources:

i. https://scikit-learn.org/stable//_downloads/scikit-learn-docs.pdf
ii. docs.python.org › library
iii. https://opencv.org/
iv. https://matplotlib.org/

III Year II Semester	COMPUTER NETWORKS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

i. Understand and apply different network commands
ii. Analyze different networking functions and features for implementing optimal solutions Apply different networking concepts for implementing network solution
iii. Implement different network protocols

Experiments:

1) Implement the data link layer farming methods such as character stuffing and bit stuffing.
2) Write a C program to develop a DNS client server to resolve the given hostname.
3) Implement on a data set of characters the three CRC polynomials – CRC-12, CRC-16 and CRC-CCIP.
4) Implement Dijkstra's algorithm to compute the Shortest path in a graph.
5) Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm
6) Take an example subnet of hosts. Obtain broadcast tree for it.
7) Write a client-server application for chat using UDP
8) Implement programs using raw sockets (like packet capturing and filtering)
9) Write a C program to perform sliding window protocol.
10) Get the MAC or Physical address of the system using Address Resolution Protocol.
11) Simulate the Implementing Routing Protocols using border gateway protocol(BGP)
12) Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.
13) Install Wireshark Tool on PC and use it to:
    a) Capture network traffic
    b) Determine default gateway address of your network
    c) Examine frame format and contents of Ethernet frames
    d) Filter and examine only ICMP traffic
    e) Run various network services like ping, ssh, dns ..etc and examine the traffic captured by Wireshark
14) Simulate a three nodes point-to-point network with duplex links between them. Set the queue size vary the bandwidth and find the number of packets dropped.
15) Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1- n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets by TCP/UDP.
16) Simulate the transmission of ping messaged over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
17) Simulate an Ethernet LAN using N-nodes (6-10), change error rate and data rate

and compare the throughput.

18) Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source/destination.

* ns2/ns3/CISCO Packet Tracet/OPNET/any other network simulator may be used for simulation experiments.

Course Outcomes:

i. Apply the basics of Physical layer in real time applications
ii. Apply data link layer concepts, design issues, and protocols
iii. Apply Network layer routing protocols and IP addressing
iv. Implement the functions of Application layer and Presentation layer paradigms and Protocols

III Year II Semester	SOFT SKILLS (SKILL ENHANCEMENT COURSE)	L	T	P	C
		0	1	2	2

Course Objectives:

i. To equip the students with the skills to effectively communicate in English
ii. To train the students in interview skills, group discussions and presentation skills
iii. To motivate the students to develop confidence
iv. To enhance the students' interpersonal skills
v. To improve the students' writing skills

UNIT – I

Analytical Thinking & Listening Skills: Self-Introduction, Shaping Young Minds - A Talk by AzimPremji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception.
Communication Skills: Verbal Communication; Non Verbal Communication (Body Language)

UNIT – II

Self-Management Skills: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities
Etiquette: Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT – III

Standard Operation Methods : Basic Grammars, Tenses, Prepositions, Pronunciation, Letter Writing; Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

UNIT-IV

Job-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

UNIT-V

Interpersonal relationships: Introduction, Importance, Types, Uses, Factors affecting interpersonal relationships, Accommodating different styles, Consequences of interpersonal relationships

Text books:

i. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
ii. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

Reference books:

i. R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018.
ii. Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

E-resources:

i. https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_CAMBR_01

III Year II Semester	TECHNICAL PAPER WRITING & IPR	L	T	P	C
		2	0	0	-

Course Objective : The course will explain the basic related to writing the technical reports and understanding the concepts related to formatting and structuring the report. This will help students to comprehend the concept of proofreading, proposals and practice

Unit I:

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

Unit II:

Drafting report and design issues: The use of drafts, Illustrations and graphics.

Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

Unit III:

Proofreading and summaries: Proofreading, summaries, Activities on summaries. **Presenting final reports:** Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

Unit IV: Using word processor:

Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes , Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros,

Unit V:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of **Patenting and Development:** technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property

Text Books:

i. KompalBansal&ParshitBansal, “Fundamentals of IPR for Beginner’s”, 1st Ed., BS Publications, 2016.
ii. William S. Pfeiffer and Kaye A. Adkins, “Technical Communication: A Practical Approach”, Pearson.
iii. Ramappa,T., “Intellectual Property Rights Under WTO”, 2nd Ed., S Chand, 2015.

Reference Books:

i. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
ii. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press(2006)

E-resources:

i. https://www.udemy.com/course/reportwriting/
ii. https://www.udemy.com/course/professional-business-english-and-technical-report-writing/
iii. https://www.udemy.com/course/betterbusinesswriting/

IV Year I Semester	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of the course is to

i. Define machine learning and its different types (supervised and unsupervised) and understand their applications.
ii. Apply supervised learning algorithms including decision trees and k-nearest neighbours (k- NN).
iii. Implement unsupervised learning techniques, such as K-means clustering.

UNIT-I: Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II: Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III: Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression. The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification, Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV: Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT-V: Clustering : Introduction to Clustering, Partitioning of Data, Matrix Factorization, Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

i. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

i. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
ii. "Machine Learning in Action",Peter Harrington, DreamTech
iii. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

IV Year I Semester	HUMAN RESOURCES & PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

IV Year I Semester	SOFTWARE ARCHITECTURE & DESIGN PATTERNS (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Outcomes

i. Understand the basic concepts to identify state behavior of real world objects
ii. Apply Object Oriented Analysis and Design concepts to solve complex problems
iii. Construct various UML models using the appropriate notation for specific problem context
iv. Design models to Show the importance of systems analysis and design in solving complex problems using case studies
v. Study of Pattern Oriented approach for real world problems

UNIT - I

Introduction: What is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern What is object oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm

UNIT – II

Analysis a System: Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading

UNIT – III

Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.

UNIT – IV

Interactive systems and the MVC architecture: Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions

UNIT – V

Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus

Text Books:

i. Object oriented analysis, design and implementation, brahma dathan, sarnathrammath , universities press,2013

ii. Design patterns, Erich Gamma, Richard helan , Ralph johman , john vlissides, PEARSON Publication,2013

Reference Books:

i. Frank Bachmann, RegineMeunier , Hans Rohnert “Pattern Oriented Software Architecture” Volume 1, 1996.
ii. William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998

IV Year I Semester	BLOCK CHAIN TECHNOLOGY (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objective:

i. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
ii. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
iii. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.
iv. To understand a "smart" contract and its legal implications.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Course Outcomes

Upon completion of the course, it is expected that student will be able to:

i. Define and explain the fundamentals of Block chain.
ii. Understand decentralization and the role of Blockchain in it.
iii. Understand and analyze Bitcioin Crypto currency and underlying Block chain network.
iv. Understand Etherium currency and platform, and develop applications using Solidity.
v. Understand Hyperledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

Text Book:

i. Mastering Blockchain, Imran Bashir, Second Edition, Packt Publishing.

Reference Books:

ii. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas Antonopoulos, O'Reilly.
iii. Blockchain Blueprint for a New Economy, Melanie Swan, O'Reilly.
iv. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
v. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press.

IV Year I Semester	INTERNET OF THINGS (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. What IoT is and how it works today and to Understand the Architectural Overview of IoT
ii. To Understand the IoT Reference Architecture and RealWorld Design Constraints
iii. To Understand the various IoT Protocols.
iv. To understand and program IoT devices.

UNIT - I: Introduction to IOT

Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real time Examples of IoT , Overview of IoT components and IoT Communication Technologies ,Challenges in IOT**.**

UNIT - II: Arduino Simulation Environment

Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino , Interfacing Arduino with LCD.

Sensor & Actuators with Arduino

Overview of Sensors working, Analog and Digital Sensors,Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino,Interfacing of Actuators with Arduino.Interfacing of Relay Switch and Servo Motor with Arduino.

UNIT - III: Raspberry Pi Programming

Installing and **Configuring** the Raspberry Pi,Getting Started with the Raspberry Pi,Using the Pi as a Media Centre, Productivity Machine and Web Server,Remote access to the Raspberry Pi. Preaparing **Raspberry Pi for IoT Projects.**

Creating the Sensor Projects,Creating the actuator Projects, Creating a IoT controller, creating a camera and working with HTTP protocol.

UNIT - IV: Basic Networking with ESP8266 WiFi module

Basics of Wireless Networking ,Introduction to ESP8266 Wi-Fi Module ,Various Wi-Fi library , Web server- introduction, installation, configuration ,Posting sensor(s) data to web server .IoT Protocols ,M2M vs. IOT Communication Protocols.

UNIT - V: Cloud Platforms for IOT

Virtualization concepts and Cloud Architecture , Cloud computing, benefits ,Cloud services -- SaaS, PaaS, IaaS , Cloud providers & offerings ,Study of IOT Cloud platforms , ThingSpeak API and MQTT , interfacing ESP8266 with Web services

Course Outcomes:

The students should be able to:

i. Recognize the factors that contributed to the emergence of IoT
ii. Design and program IoT devices like Microcontrollers, sensors and actuators.
iii. Use real IoT protocols for communication.
iv. Define the infrastructure for supporting IoT deployment.
v. Design an IoT device to work with a Cloud Computing infrastructure and Transfer IoT data to the cloud and in between cloud providers.

Text Books:

i. Simon Monk, Programming Arduino: Getting Started with Sketches, Second Edition McGraw- Hill Education
ii. Peter Waher,Learning Internet of Things,Packt publishing. iii.OvidiuVermesan,PeterFriess, IoT-From Research and Innovation to Market deployment,River Publishers

Reference Books:

i. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
ii. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
iii. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

IV Year I Semester	QUANTUM COMPUTING (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

This course teaches the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory.

UNIT –I:
Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:
Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:
Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:
Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:
Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Course Outcomes:
By the end of this course, the student is able to

i. Analyze the behaviour of basic quantum algorithms
ii. Implement simple quantum algorithms and information channels in the quantum circuit model
iii. Simulate a simple quantum error-correcting code
iv. Prove basic facts about quantum information channels
v. Know about Quantum Computing Models

Text Books:

i. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia "Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/ O'Reilly.
ii. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt
iii. V.K Sahni, Quantum Computing (with CD), TATA McGrawHill.

IV Year I Semester	SOFT COMPUTING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities. Soft Computing is a consortia of methodologies which collectively provide a body of concepts and techniques for designing intelligent systems.

UNIT-I:

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

UNIT-II:

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons , Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications

UNIT-III:

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification

UNIT-IV:

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

UNIT-V:

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

GA based Backpropagation Networks: GA based Weight Determination, K - factor determination in Columns.

Fuzzy Backpropagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Reference Books:

i. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
ii. Genetic Algorithms: Search and Optimization, E. Goldberg.
iii. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
iv. Build_Neural_Network_With_MS_Excel_sample by Joe choong

IV Year I Semester	HUMAN COMPUTER INTERACTION (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives: The main objective is to get student to think constructively and analytically about how to design and evaluate interactive technologies.

UNIT I:

Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession Managing **Design Processes:** Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories

UNIT II:

Menu Selection, Form Fill-In and Dialog Boxes: Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays

UNIT III:

Command and Natural Languages: Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large.

UNIT IV:

Quality of Service: Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color.

UNIT V:

User Documentation and Online Help:

Introduction, Online Vs Paper Documentation, Reading from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, The Development Process.

Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization

Course Outcomes:

i. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
ii. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
iii. Apply an interactive design process and universal design principles to designing HCI systems.
iv. Describe and use HCI design principles, standards and guidelines.
v. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.
vi. Discuss tasks and dialogs of relevant HCI systems based on task analysis and dialog design.

Text Books:

i. Designing the User Interface, Strategies for Effective Human Computer Interaction, 5ed, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, Pearson
ii. The Essential guide to user interface design,2/e, Wilbert O Galitz, Wiley DreamaTech.

Reference Books

i. Human Computer, Interaction Dan R.Olsan, Cengage ,2010.
ii. Designing the user interface. 4/e, Ben Shneidermann , PEA.
iii. User Interface Design, Soren Lauesen , PEA.
iv. Interaction Design PRECE, ROGERS, SHARPS, Wiley.

IV Year I Semester	DIGITAL IMAGE PROCESSING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

i. To become familiar with digital image fundamentals
ii. To get exposed to simple image enhancement techniques in Spatial and Frequency domain
iii. To learn concepts of degradation function and restoration techniques
iv. To study the image segmentation and representation techniques
v. To become familiar with image compression and recognition methods

UNIT- I:
Digital Image Fundamentals: Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels.

UNIT -II:
Image Enhancement: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering.

UNIT –III:
Image Restoration: Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT -IV:
Image Segmentation: Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT –V:
Image Compression and Recognition: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Course Outcomes:

At the end of the course, the students will be able to:

i. Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms
ii. Operate on images using the techniques of smoothing, sharpening and enhancement. iii. Use the restoration concepts and filtering techniques
iv. Illustrate the basics of segmentation
v. Understand Image Compression and Recognition techniques

Text Books:

i. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2010.

ii. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.

Reference Books:

i. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
ii. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing, Prentice Hall Professional Technical Reference, 1990.
iii. William K. Pratt, Digital Image Processing, John Wiley, New York, 2002.

IV Year I Semester	MOBILE ADHOC NETWORKS (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

i. To learn about the issues and challenges in the design of wireless ad hoc networks.
ii. To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
iii. To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
iv. To understand various security issues in ad hoc and sensor networks and the corresponding solutions.

UNIT-I: Routing:
Cellular and Ad hoc wireless networks, Issues of MAC layer and Routing, Proactive, Reactive and Hybrid Routing protocols, Multicast Routing, Tree based and Mesh based protocols, Multicast with Quality of Service Provision

UNIT-II: Quality of Service:

Real-time traffic support , Issues and challenges in providing QoS , Classification of QoS Solutions ,MAC layer classifications ,QoS Aware Routing Protocols ,Ticket based and Predictive location based QoS Routing Protocols

UNIT-III:
Energy Management Ad Hoc Networks:

Need for Energy Management, Classification of Energy Management Schemes, Battery Management and Transmission Power Management Schemes, Network Layer and Data Link Layer Solutions, System power Management schemes

UNIT-IV:
Mesh Networks:

Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing,
Self Configuration and Auto Configuration, Capacity Models, Fairness, Heterogeneous Mesh Networks, Vehicular Mesh Networks

UNIT -V:
Sensor Networks:

Introduction –,Sensor Network architecture , Data Dissemination ,Data Gathering ,MAC Protocols for sensor Networks, Location discovery, Quality of Sensor Networks ,Evolving Standards ,Other Issues, Recent trends in Infrastructure less Networks

Course Outcomes:

i. Know the basics of Ad hoc networks and Wireless Sensor Networks.
ii. Identify the issues and challenges in providing QoS.
iii. To know how the resources are managed in the network.
iv. To get an idea about various types of mesh networks.
v. Specify and identify deficiencies in existing wireless protocols for MAC layer and Network layer, and then go onto formulate new and better protocols.

Text Books:

i. C.Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education.
ii. Holger Karl, Andreas Willing, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons, Inc.

Reference Books:

i. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, Ad Hoc Mobile Wireless Networks, Auerbach Publications.
ii. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing.
iii. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons.

IV Year I Semester	Constitution of India	L	T	P	C
		2	0	0	-

Course Objectives:

i. Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective.
ii. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indiannationalism.
iii. To address the role of socialism in India after the commencement of theBolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT–I: History of Making of the IndianConstitution: History, Drafting Committee, (Composition & Working)
Philosophy of the IndianConstitution- Preamble, Salient, Features

UNIT–II: Contours of Constitutional Rights &Duties: Fundamental Rights, Right toEquality, Right toFreedom, Right againstExploitation, Right to Freedom ofReligion, Cultural and EducationalRights, Right to ConstitutionalRemedies, Directive Principles of StatePolicy, Fundamental Duties.

UNIT–III: Organs ofGovernance: Parliament, Composition, Qualifications andDisqualifications, Powers andFunctions, **Executive-** President, Governor, Council ofMinisters, Judiciary, Appointment and Transfer of Judges,Qualifications, Powers andFunctions

UNIT–IV: LocalAdministration: District's Administration head: Role andImportance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of MunicipalCorporation, Pachayati raj: Introduction, PRI:ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position androle, Block level: Organizational Hierarchy (Differentdepartments), Village level: Role of Elected and Appointedofficials, Importance of grass rootdemocracy

UNIT–V: ElectionCommission: Election Commission: Role andFunctioning, Chief Election Commissioner and ElectionCommissioners, State Election Commission: Role andFunctioning, Institute and Bodies for the welfare of SC/ST/OBC andwomen.

Text Books:

i. The Constitution of India, 1st Edition, (Bare Act), GovernmentPublication, 1950
ii. Framing of Indian Constitution, 1st Edition,Dr. S. N. Busi, Dr. B. R. Ambedkar2015

Reference Books:

i. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis,2014