Scheme of Instruction, Examination

(With effect from the academic year 2021-22)

M.Tech I to IV Semesters

of

Two Year Post Graduate Programme

&

Syllabus of M.Tech I to IV Semesters

In

Computer Science & Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE(A)
NADERGUL, HYDERABAD-501510
(Sponsored by Matrusri Education Society, Estd.1980)
Approved by AICTE & Affiliated to Osmania University, Estd.1981
ISO 9001:2015 Certified Institution, Accredited by NAAC
website: www.mvsrec.edu.in

2021

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE, NADERGUL

(An Autonomous Institution)

Ref: MVSREC/CS F–02 Date: 26-10-2021

Meeting Notice

All the members of BOS of M.Tech (CSE) are requested to attend the meeting scheduled at 11 am on 01-11-2021 in an online mode.

Following is the agenda of the meeting:

Agenda:

1. To Discuss and approve the course structure and syllabi of I & II years of the 2 year PG degree course.
2. Any other item with the permission of Chair.

Chairman BOS

HEAD
Dept. of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510

MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE
NADERGUL, HYDERABAD-501510
(Sponsored by Matrusri Education Society, Estd.1980)
Approved by AICTE & Affiliated to Osmania University, Estd.1981
ISO 9001:2015 Certified Institution, Accredited by NAAC
website: www.mvsrec.edu.in

Dt: 01-11-2021

Board of Studies for PG Program (M.Tech - CSE) in Department of Computer Science & Engineering

The following is the list of members in the Board of Studies for the approval of the M.Tech (CSE) Course structure and Syllabi under Autonomous batch for the Academic Year 2021 - 2022

S.No	Name of the Member	Designation and Official Address with Phone and Email	Designation in the Board of Studies	Signature
1	Prof.J.Prasanna Kumar	Professor & Head, Department of CSE, MVSREC, Hyderabad Ph. No: 9885921778 Email: prasannakumar@mvsrec.edu.in	Chairman, Board of Studies	
2	Dr.K.Venugopal Rao	Professor, Department of CSE, MVSREC, Hyderabad Ph. No: 9849025342 Email: kvgrao1234@gmail.com	Subject Expert (AI & Machine Learning)	
3	Dr.Sesham Anand	Professor, Department of CSE, MVSREC, Hyderabad Ph. No: 9912041480 Email: anand_cse@mvsrec.edu.in	Subject Expert (Data Mining)	
4	Dr.B.Sandhaya	Professor, Department of CSE, MVSREC, Hyderabad Ph. No: 9848509044 Email: sandhya_cse@mvsrec.edu.in	Subject Expert (Artificial Intelligence)	
5	Dr.Rajesh Kulkarni	Associate Professor, Department of CSE, MVSREC, Hyderabad Ph. No: 9404644123 Email: kulkarni_cse@mvsrec.edu.in	Subject Expert (Block Chain Technology and Data Science)	
6	B.Saritha	Associate Professor, Department of CSE, MVSREC, Hyderabad Ph. No: 9000801785 Email: bsaritha_cse@mvsrec.edu.in	PG Coordinator (AI & Machine Learning, Networks)	
7	Dr.P.V.Sudha	Professor, Department of CSE, University college of Engineering, OU, Hyderabad, Telangana, India Ph. No: 94927 54480 E.Mail : pvsudha@uceou.edu	University nominated Member	P.V.Sudha Professor, Dept. of Computer Science & Eng. University College of Engineering Osmania University, Hyd-500007
8	Dr.Wilson Naik	Associate Professor, Department of CS, HCU, Hyderabad. Ph.No.: 9912328227 Email:	Subject Expert from HCU	
9	Mr.Bala Prasad Peddigari	Chief Products Officer - HiTech CTO Engineering Team at Tata Consultancy Services Ph. No-9295081188, Email: bala.peddigari@tcs.com	Representative from Industry	
10	P.Sammulal	Professor of CSE JNTUH College of Engineering Jagtial. Ph.No: 8897717222 Email: sammulalporika@gmail.com sam@jntuh.ac.in	Subject Expert from JNTU	
11	Mrs. V.Anusha	Software Analyst, Intergraph Consulting Pvt Ltd, Hyderabad, Telangana, India Ph. No: 8019388173 Email: vajrapuanusha@gmail.com	Post Graduate Alumni	

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE, NADERGUL

Date: 01-11-2021

Minutes of the BOS meeting held on 01.11.2021 in the Dept. of CSE

- BOS chairperson has welcomed all the members of BOS committee.
- On behalf of Dept. of CSE, BOS chairperson has authorized Prof. Venugopal Rao to brief the course structure and syllabus for the approval of 2 years M.Tech (CSE) P.G. course structure for Autonomous Batch starting from 2021 onwards.
- Prof. Venugopal Rao has briefed and explained the course structure with corresponding credits for the courses of 2 years M.Tech (CSE) P.G. and briefed the syllabus for the courses of
    - Data Science
    - Advanced Machine Learning
    - Internet Of Things
    - Secure Software Design and Enterprise Computing
    - Natural Language Processing
    - Soft Computing & Techniques
    - Cloud Computing
    - Distributed Databases
    - Software Project Management
    - Software Design Pattern
    - Software Quality & Testing
    - Cryptography & Network Security
    - Mobile Computing
    - Adhoc & Wireless Sensor Networks
    - Blockchain Technology
- External members have suggested to incorporate few changes in the Professional Elective Courses and also suggested to give more weightage to the LAB programs of the corresponding courses.

- Dr. P.V Sudha and Prof. Wilson Naik have suggested to give provision for the hands-on session and domain tracks in the course structure. They also suggested and recommended to introduce advanced courses in the domains of Networks and Security along with Artificial Intelligence, Machine Learning areas etc.
- BOS members suggested the Internship Program to be continued and it should be given weightage in the form of credits which should be carried out in the summer break after second semester.

Chairman BOS.

HEAD
Dept.of Computer Science & Engineering
M.V.S.R.ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510

P.V. Sudha
Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd-500 007

SCHEME OF INSTRUCTION & EXAMINATION
M. Tech. (Computer Science and Engineering) I – Semester

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	P21PC001CS	Artificial Intelligence	3	1	-	4	30	70	3	4
2	P21PC002CS	Advanced Data Structures	3	-	-	3	30	70	3	3
3		Professional Elective–I	3	-	-	3	30	70	3	3
4		Professional Elective–II	3	-	-	3	30	70	3	3
5	P21MC001CS	Research Methodology & IPR	3	-	-	3	30	70	3	3
6		Audit Course–I	2	-	-	2	30	70	3	0
Practical/ Laboratory Courses										
7	P21PC801CS	Laboratory–I (Core)	-	-	2	2	50	-	3	1
8		Laboratory – II (Elective) -I	-	-	2	2	50	-	3	1
		Total	**17**	**01**	**04**	**21**	**280**	**420**		**18**

PC: Program Core **PE:** Professional Elective **OE**: Open Elective
AD: Audit Course **MC**: Mandatory Course **HS**: Humanities and social science

L: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a Particular laboratory.
3. *If the Mandatory Course is offered in I-Semester, the Open Elective course should be offered in II-semester. If Open Elective course is offered in I-Semester, then the Mandatory Course should be Offered in II-semester.
4. **Open Elective Subject is not offered to the students of CSE and IT Department.

P.V. Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd-500 007

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510.

SCHEME OF INSTRUCTION & EXAMINATION
M. Tech. (Computer Science and Engineering) II–Semester

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	P21PC003CS	Advanced Algorithms	3	-	-	4	30	70	3	3
2	P21PC004CS	Mathematical Foundation of Computer Science	3	-	-	3	30	70	3	3
3		Professional Elective–III	3	-	-	3	30	70	3	3
4		Professional Elective–IV	3	-	-	3	30	70	3	3
5		Audit Course–II	2	-	-	2	30	70	3	0
Practical/ Laboratory Courses										
6	P21PC802CS	Laboratory–III (core)	-	-	2	2	50	-	3	1
		Laboratory–IV (elective)–III	-	-	2	2	50	-	3	1
7		Technical Seminar	-	-	4	4	50	-	3	2
		Total	**14**	**02**	**08**	**24**	**300**	**350**		**16**

PC: Program Core **PE:** Professional Elective **OE**: Open Elective
AD: Audit Course **MC**: Mandatory Course **HS**: Humanities and social science

L:Lecture **T**:Tutorial **P**:Practical **D**:Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ.Exam)

Note:

1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a Particular laboratory.
3. **Open Elective Subject is not offered to the students of CSE and IT Department.
4. Internship is carried out during the summer break.

P.V. Subba Rao
Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd.-500 007

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510.

SCHEME OF INSTRUCTION & EXAMINATION
M. Tech. (Computer Science and Engineering) III–Semester

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1		Open Elective	3	-	-	3	30	70	3	3
2		Professional Elective–V	3	-	-	3	30	70	3	3
3	P21PW801CS	Major Project Phase–I	-	-	20	20	100	-	3	10
4		Internship	-	-	-	-	-	-	-	2
		Total	**06**	**-**	**20**	**26**	**160**	**140**		**18**

P.V. Sobha
Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd-500 007

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510

SCHEME OF INSTRUCTION & EXAMINATION
M. Tech. (Computer Science and Engineering) IV – Semester

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	P21PW802CS	Major Project Phase – II (Dissertation)	-	-	32	32	-	200	3	16
		Total	**-**	**-**	**32**	**32**	**-**	**200**		**16**

PC: Program Core **PE:** Professional Elective **OE**: Open Elective
AD: Audit Course **MC**: Mandatory Course **HS**: Humanities and social science

L:Lecture **T**:Tutorial **P**:Practical **D**:Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination(Univ.Exam)

Note:

1. Each contact hour is a Clock Hour
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a Particular laboratory.
3. **Open Elective Subject is not offered to the students of CSE and IT Department.
4. The students who are willing to register for MOOCs in the M. Tech (CSE) III – semester instead of Professional Electives – IV & V, should register for those of the courses, approved by the CBoS, OU and respective college MOOCs Coordinator. Those students are strictly not permitted to appear for either CIE or SEE of Professional Electives – IV & V if they abstain from attending the semester classwork. Further, for students willing to appear for both MOOCS and Professional Electives, they Should fulfil the minimum attendance criteria.

Total number of credits entire PG program of 4 semesters is 68 (1st Sem to 4thsem – 18 +16+18+16)

P.V.R...
Professor;
Dept. of Com... Science & Engg
University ... of Engineering
Osmania University, Hyd-500 ...

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510.

List of subjects of Professional Core

S. No	Course Code	Course Title
1	P21PC001CS	Mathematical Foundation of Computer Science
2	P21PC002CS	Advanced Data Structures
3	P21PC003CS	Advanced Algorithms
4	P21PC004CS	Artificial Intelligence

List of Professional Core Subjects based Laboratory Courses

S. No.	Course Code	Course Title
1	P21PC801CS	Advanced Data Structures using C++ Lab
2	P21PC802CS	Advanced Algorithms using C++ Lab

ELECTIVE I (Theory)		
S.No.	Course Code	Course Title
1	P21PE001CS	Advanced Machine Learning
2	P21PE002CS	Internet Of Things
3	P21PE003CS	Cyber Security and Digital Forensics
4	P21PE004CS	Secure Software Design and Enterprise Computing

ELECTIVE I (Laboratories)		
S.No.	Course Code	Course Title
1	P21PE801CS	Advanced Machine Learning using python Lab
2	P21PE802CS	Internet Of Things Lab
3	P21PE803CS	Cyber Security and Digital Forensics Lab
4	P21PE804CS	Secure Software Design and Enterprise Computing Lab

ELECTIVE II		
S.No.	Course Code	Course Title
1	P21PE005CS	Natural Language Processing
2	P21PE006CS	Block Chain Technology
3	P21PE007CS	Distributed Data Bases
4	P21PE008CS	Software Project Management

P.V. Sridhar
Professor,
Dept. of Computer Science & Engg
University College of Engineering

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510

ELECTIVE III (Theory)		
S.No.	Course Code	Course Title
1	P21PE009CS	Data Science using R
2	P21PE010CS	Advanced Computer Networks
3	P21PE012CS	Cloud Computing

ELECTIVE III (Laboratories)		
S.No.	Course Code	Course Title
1	P21PE809CS	Data Science using R Lab
2	P21PE810CS	Advanced Computer Networks Lab
3	P21PE812CS	Cloud Computing Lab

ELECTIVE IV		
S.No.	Course Code	Course Title
1	P21PE013CS	Soft Computing & Techniques
2	P21PE014CS	Mobile Computing
3	P21PE015CS	Software Architecture and Design Pattern
4	P21PE016CS	Software Quality & Testing

ELECTIVE V		
S.No.	Course Code	Course Title
1	P21PE017CS	Artificial Neural Networks
2	P21PE018CS	Cryptography & Network Security
3	P21PE019CS	Adhoc & Wireless Sensor Networks

P.V.S.

Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd-500 007

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510.

List of Mandatory Courses

S. No.	Course Code	Course Title
1	P21MC001CS	Research Methodology & IPR

List of Open Electives

S. No.	Course Code	Course Title
1	P21OE001CE	Cost Management of Engineering Projects
2	P21OE002CS**	Business Analytics
3	P21OE003EC	Embedded System Design
4	P21OE004EE	Waste to Energy
5	P21OE005ME	Industrial Safety

Note:**Open Elective Subject is not offered to the students of CSE

List of subjects of Audit Course-I

S. No.	Course Code	Course Title
1	P21AD001HS	English for Academic and Research Writing
2	P21AD002HS	Disaster Management
3	P21AD003HS	Sanskrit for Technical Knowledge
4	P21AD004HS	Value Education

List of subjects of Audit Course-II

S. No.	Course Code	Course Title
1	P21AD005HS	Constitution of India and Fundamental Rights
2	P21AD006HS	Pedagogy Studies
3	P21AD007HS	Stress Management by Yoga
4	P21AD008HS	Personality Development through life Enlightenment Skills

P.V. Sudha
Professor,
Dept. of Computer Science & Engg
University College of Engineering
Osmania University, Hyd-500 007

HEAD
Dept.of Computer Science & Engineering
M.V.S.R ENGINEERING COLLEGE
Nadergul, Hyderabad-501 510.

Scheme of Instruction, Examination

(With effect from the academic year 2021-22)

M.Tech I to IV Semesters

of

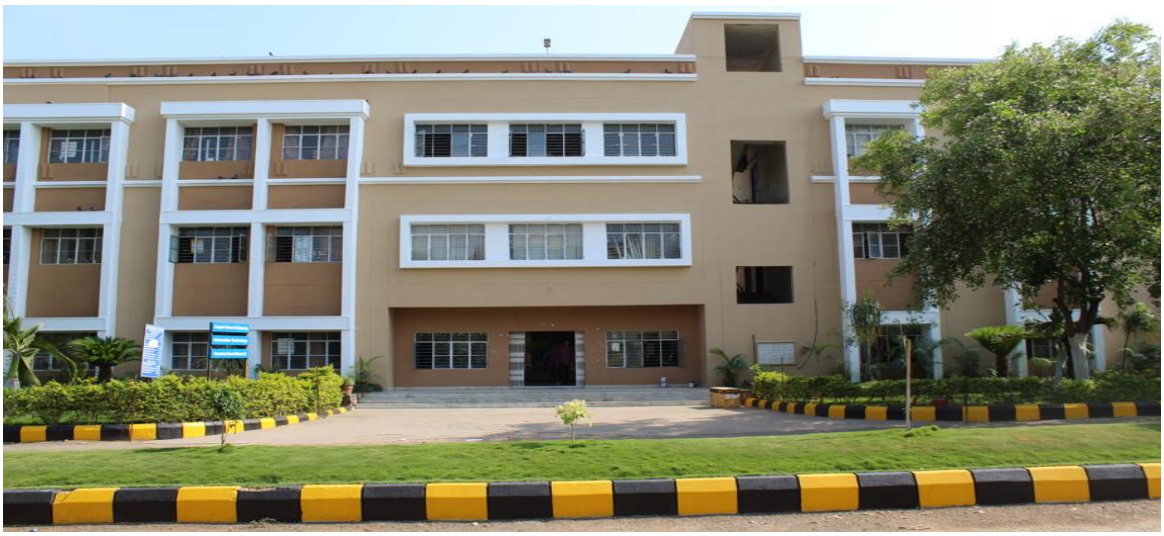
Two Year Post Graduate Programme

&

Syllabus of M.Tech I to IV Semesters

In

Computer Science & Engineering



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE(A)
NADERGUL, HYDERABAD-501510
(Sponsored by Matrusri Education Society, Estd.1980)
Approved by AICTE & Affiliated to Osmania University, Estd.1981
ISO 9001:2015 Certified Institution, Accredited by NAAC
website: www.mvsrec.edu.in

2021

Course Code	Course Title					Core/Elective
P21PC004CS	**Mathematical foundations for Computer Science**					Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
		T	D	P			
-		**1**	**-**	**-**	**30**	**70**	**4**

Course Objectives :

- To understand the mathematical fundamentals that is prerequisites for a variety of courses like
- Data mining, Network protocols, analysis of Web traffic, Computer security, Software
- engineering, Computer architecture, operating systems, distributed systems, Bioinformatics,
- Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in
- Information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

Course Outcomes :

After completion of course, students would be able to:

- Apply suitable reasoning techniques and proofs in problem solving.
- Apply graph theory in computer science applications.
- Design and analysis of algorithms in computational problems.
- Apply various probability theories and design stochastic processes.
- Able to create solutions by applying the mathematical techniques for solving engineering applications in computer science

UNIT – I

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

UNIT-II

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.

UNIT – III

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over fitting model assessment. Pictorial and tabular methods in Descriptive Inference.

UNIT – IV

Markov chains, Hidden Markov models, Queuing models, Markov Chain Monte Carlo

UNIT – V

Recent trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Suggested books:

1. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley.
2. Miller & Freund's, Probability and Statistics For Engineers, by Richard A. Johnson, Eight Edition, PHI.
3. T. Veerarajan, Probability, Statistics and Random Processes, Second Edition, Tata McGraw-Hill.
4. Jay L. Devore, Probability and Statistics For Engineering and Sciences, Eighth Edition.

Reference Books:

1. John Vince, Foundation Mathematics for computer Science, Springer
2. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and ProbabilisticAnalysis.
3. Alan Tucker, Applied Combinatorics, Wiley

Course Code	Course Title						Core/Elective
P21PC002CS	Advanced Data Structures						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- Tofamiliarizestudentswithadvancedparadigmsanddatastructureusedtosolvealgorithmicproblems.
- Studentshouldbeabletocomeupwithanalysisofefficiencyandproofsofcorrectness.

Course Outcomes

After completion of course, students would be able to:

- Understand the implementation of symbol table using hashing techniques.
- Develop and analyse algorithms furred-black trees, B-trees and Splay trees.
- Develop algorithms for text processing applications.
- Identify suitable data structures and develop algorithms for computational geometry problems.

UNIT-I

Dictionaries: Definition, Dictionary
Abstract Data Type, Implementation of Dictionaries.
Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT-II

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

UNIT-III

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3Trees, B-Trees, Splay Trees

UNITIV

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT-V

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

Suggested Readings:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, JohnWiley,2002.

Course Code	Course Title						Core/Elective
P21PC003CS	**Advanced Algorithms**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**1**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Introduce students to the advanced methods of designing and analyzing algorithms
- The student should be able to choose appropriate algorithms and use it for a specific problem.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes

After completion of course, students would be able to:

- Analyse the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- Students should have an insight of recent activities in the field of the advanced data structure.

UNIT-I

Sorting: Review of various sorting algorithms, topological sorting, Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of a mortised analysis.

UNIT-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.
String Matching: Naive String Matching, Rabin-Karp algorithm, matching with finite Automata, Knuth- Morris - Pratt algorithm.

UNIT-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT-IV

Shortest Path in Graphs: Floyd - Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.
Discrete Fourier Transform(DFT): Incomplex field, DFT in moduloring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

UNIT-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm
NP-completeness: Polynomial time, polynomial time verification, Examples, proof of NP-hardness and NP-completeness.
Approximation algorithms, Vertex cover Problem , Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm. Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures

Suggested Books:

1. "Introduction to Algorithms", Cormen, Leiserson, Rivest, Stein, 4th edition, McGraw Hill,
2. "The Design and Analysis of Computer Algorithms" Aho, Hopcroft ,Ullman.
3. "Algorithm Design" Kleinberg and Tardos.
4. " Fundamentals of Computer Algorithms", Ellis Horowitz, Satraj Sahni and Rajasekharam, Galgotia Publications pvt.Ltd.
5. "Design and Analysis Algorithms" Parag Himanshu Dave, Himanshu Bhalchandra Dave Publisher: Pearson
6. "Algorithm Design: Foundations, Analysis and Internet examples", M.T. Goodrich and R. Tomassia, John Wiley and sons.
7. "Data structures and Algorithm Analysis in C++", Allen Weiss, Second edition, Pearson education

Course Code	Course Title						Core/Elective
P21PC001CS	**Artificial Intelligence**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To present an overview of artificial intelligence (AI) principles and approaches.
- Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.
- Students will implement a small AI system in a team environment.
- The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program**.**

Course Outcomes:

After completion of course, students would be able to:

- To design a knowledge based system.
- To develop a model for reasoning with uncertainty as well as use of unreliable information.
- To be able to use different solutions from machine learning techniques and artificial neural networks algorithms.
- To analyse important historical and current trends addressing artificial intelligence.

UNIT - 1

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of Al, Applications.

Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem-Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative - Deepening A*, Constraint Satisfaction.

Game Playing, Bounded Look - ahead Strategy and use of Evaluation Functions, Alpha Beta Pruning.

UNIT - II

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Table, A System in Propositional Logic, Resolution, Refutation in Propositional Logic, Predicate Logic

Knowledge Representation: Introduction, Approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT - III

Planning - A Simple Planning Agent, Form Problem Solving to Planning, Basic representation of plans, partial order planning, hierarchical planning
Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems
Uncertainty Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster - Shafer Theory.

UNIT - IV

Machine - Learning Paradigms: Introduction, Machine learning System, Supervised and Unsupervised Learning, Inductive and Deductive Learning, Learning Decision Trees, Clustering
Artificial Neural Networks: Introduction Artificial Neural Networks, Single - Layer Feed Forward Networks, Multi - Layer Feed Forward Networks, Radial - Basis Function Networks
Reinforcement learning – Learning from rewards, Passive and Active reinforcement learning, Applications

UNIT - V : Current trends/applications of AI

Natural language Processing, Text Processing, Automatic Speech recognition, Chatbot
Computer Vision: Autonomous Navigation, Industry 4.0

Suggested Books:

1. Russell, Norvig, *Artificial Intelligence: A Modern Approach*, Pearson Education, 2nd Edition, 2004.
2. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, First Edition, 2011.
3. Rich, Knight, Nair, *Artificial Intelligence*, Tata McGraw Hill, 3rd Edition 2009.

Course Code	Course Title						Core/Elective
P21PC801CS	**Advanced Data Structures using C++ Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**50**	-	**1**

Course Outcomes

After Completing This Course, the student will be able to:

- Implement various algorithm by use of most suitable data structure
- Identify the techniques for performing various types of operations using data structures.
- Implement various functions required to provide solutions to real time problems with use of advanced data structures

List of Experiments:

1. Write a program that implements stack and Queue Operations Using
   a. Arrays
   b. linked list
2. Write a program to perform the following operations on singly linked list and doubly linked list
   a. Creation
   b. Insertion
   c. Deletion
   d. Traversal.
3. Implement recursive and non-recursive i) Linear search ii) Binary search
4. Study and Implementation of Different sorting algorithms and FindTime Space complexities.
5. Implement Recursive Functions To Traverse The Given Binary Tree In
   a. Preorder
   b. Inorder
   c. Postorder
6. Study and Implementation of different operations on
   a. Binary Search Tree
   b. AVL tree
   c. Red Black Tree
7. Perform The Following Operations
   a. Insertion into B-tree
   b. Deletion from B-tree
8. Implement Different Collision Resolution Techniques.
9. Study and Implementation of Following String Matching Algorithms:
   a. Rabin-Karp algorithm
   b. Knuth-Morris-Pratt algorithm
   c. Boyer-Moore algorithm

10. Implement The Following Using Java:
    1. Single Source Shortest Path algorithms
    2. All Pairs Shortest Path Algorithms
    3. Minimal Spanning Tree algorithms
    4. String And Pattern Matching Algorithms
    5. Maximum Flow/Minimum Cut Algorithms

Note: The Students have to submit are port at the end of the semester.

Course Code	Course Title						Core/Elective
P21PC802CS	**Advanced Algorithms using C++Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**50**	**-**	**1**

Course Outcomes

After completing this course, the student will be able to:

- Understand the applications of different data structures solve complex problems
- Apply various algorithms for diverse problems and measure the performance of various algorithms.

List of Experiments:

1. Summary/recap on complexity and NP-complete problems.
2. Dynamic Programming: characterization, diverse problems.
3. Greedy Algorithms: characterization, diverse problems.
4. Methods for solving NP-complete problems (branch and bound, graph exploration, heuristics based greedy/random/optimization approaches)

Course Code	Course Title						Core/Elective
P21PE009CS	**Data Science Using R**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To provide fundamental knowledge on data science and to understand the role of statistics and optimization to perform mathematical operation in the field of data science.
- To understand the process of handling heterogeneous data and visualize them for better understanding.
- To gain the fundamental knowledge on various open-source data science tools and understand their process of applications to solve various industrial problems.

Course Outcomes:

Ability to obtain fundamental knowledge on data science.

- Demonstrate proficiency in statistical analysis of data.
- Develop mathematical knowledge and study various optimization techniques to perform data science operations.
- Handle various types of data and visualize them using through programming for knowledge representation.
- Demonstrate numerous open-source data science tools to solve real-world problems through industrial case studies.

UNIT -1

Basics of data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems, Structured and unstructured data.

Algorithmic Foundations: Linear algebra Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes, elementary spectral graph theory, Sampling and VC-dimension – Random walks and graph sampling, MCMC algorithms, learning, linear and non-linear separators, PAC learning

UNIT – 2

Programming Foundation and Exploratory Data Analysis: Introduction to Python Programming, Types, Expressions and Variables, String Operations, selection, iteration, Data Structures – Strings, Regular Expression, List and Tuples, Dictionaries, Sets; Exploratory Data Analysis (EDA) – Definition, Motivation, Steps in data exploration, The basic datatypes, Data type Portability, Basic Tools of EDA, Data Analytics Life cycle, Discovery.

UNIT – 3

Data Handling and Visualization: Data Acquisition, Data Pre-processing and Preparation, Data Quality and Transformation, Handling Text Data; Introduction to data visualization, Visualization workflow: describing data visualization workflow, Visualization Periodic Table; Data Abstraction – Analysis: Four Levels for Validation – Task Abstraction – Analysis: Four Levels for Validation Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial

UNIT – 4

Optimization: Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Introduction to non-gradient techniques; Introduction to least squares optimization

UNIT – 5

Data Science Tools and Techniques: Overview and Demonstration of Open source tools such as R, Octave, Scilab. Python libraries: SciPy and sci-kitLearn, PyBrain, Pylearn2; Weka.

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications,2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly,2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly,2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing,2016.
5. Rafael A Irizarry, Introduction to Data Science, LeanPublishing,2016.
6. Cathy O'Neiland Rachel Schutt. Doing Data Science, Straight Talk from The Frontline.O'Reilly.
7. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Course Code	Course Title						Core/Elective
P21PE001CS	**Advanced Machine Learning**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To learn the concept of how to learn patterns and concepts from data correlation.
- To design and analyse various machine learning algorithms and techniques with modern outlook focusing recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes

After Completing This Course, the student will be able to:

- Extract features that can be used for a particular machine learning approach in various applications.
- To compare and contrast pros and cons of various machine learning techniques and to get an insight when to apply particular machine learning approach.
- To mathematically analyse various machine learning approaches and paradigms.

Unit-1

Introduction: Representation and Learning: Feature Vectors, Feature Spaces, Feature Extraction and Feature Selection, Learning Problem Formulation

Types of Machine Learning Algorithms: Parametric and Nonparametric Machine Learning Algorithms, Supervised, Unsupervised, Semi-Supervised and Reinforced Learning.

Linear Algorithms: Linear Regression, Logistic Regression, Linear Discriminant Analysis

Unit-2

Nonlinear Algorithms: Classification and Regression Trees, Naïve Bayes, K-Nearest Neighbors, Learning, Vector Quantization, Support Vector Machines.

The Bias-Variance Trade-Off, Overfitting and Underfitting

Ensemble Algorithms: Bagging and Random Forest, Boosting and AdaBoost

Unit-3

Probabilistic Model-Based Clustering: Fuzzy Clusters Probabilistic Model-Based Clusters, Expectation-Maximization Algorithm Introduction to clustering, Similarity measures, categories of clustering algorithms, EM.

Clustering High-Dimensional Data: Clustering High-Dimensional Data: Problems, Challenges and Major Methodologies, Subspace Clustering Methods, Biclustering, Dimensionality Reduction Methods and Spectral Clustering

Unit-4

Neural Networks: Multilayer Perceptrons, Back-propagation, Training strategies, Activation Functions Gradient Descent For Machine Learning, Vanishing and exploding gradients.
Convolutional Neural Networks, CNN Architecture (LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet)
Autoencoders: Denoising autoencoder, Sparse Autoencoder, Contractive Autoencoder, Variational Autoencoder, Deep Autoencoder, Undercomplete Autoencoder, Convolutional Autoencoder.

Unit-5

Recurrent Neural Networks, Back propagation through time (BPTT), Truncated BPTT, GRU, LSTMs
Object Detection: RCNN, Fast RCNN, Faster RCNN, YOLO.
Generative Adversarial Networks and applications.

Suggested Books:

1. Machine Learning, Tom Mitchell, McGraw Hill.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition
3. Pattern Recognition and Machine Learning Christopher M. Bishop
4. Machine Learning: An Algorithmic Perspective, Second Edition (Chapman & Hall/Crc Machine Learning & Pattern Recognition)
5. Pattern Recognition: An Introduction M Narasimha Murty; VSusheela Devi
6. Jason Brownlee, Master Machine Learning Algorithms Discover How They Work and Implement Them From Scratch.
7. Deep Learning By Ian Goodfellow, Yoshua Bengio and Aaron Courville

Course Code	Course Title						Core/Elective
P21PE002CS	**Internet Of Things**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives: In this course the students will explore various elements of Internet of Things such as Sensors, Actuators, Development-boards, Networking and Cloud.

Students understanding will be enhanced by:-

- Exploration towards the integration of the physical and logical worlds
- Exposure in understanding how IoT devices are designed & developed
- Understanding the various architectural designs in implementing IoT solutions

Course Outcomes: After successful completion of this course, student will be able to:-

- Judge IoT's role in enabling technologies (Evaluate)
- Suggest components of an IoT Architecture for various application sectors (Knowledge)
- Work with Arduino based IoT applications (Apply)
- Develop Python based IoT solutions (Create)
- Define requirements for IoT projects based on Raspberry Pi (Analyze)

UNIT-I

Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT-II

IoT and M2M- Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT-III

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

UNIT-IV

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors

Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor

UNIT-V

IoT Physical Servers and Cloud Offerings– Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework, Designing a RESTful web API

Suggested Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895.
4. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan.
5. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014.
6. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
7. Introduction and Fundamentals of IoT: Connecting Things – offered by CISCO.
8. NetAcad Arduino – offered by IITB-Spoken Tutorial.
9. Getting Started with Raspberry Pi – offered by Geek University.
10. Programming with Raspberry Pi – offered by Udemy.

Course Code	Course Title						Core/Elective
P21PE004CS	**Secure Software Design and Enterprise Computing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To fix software flaws and bugs in various software.
- To make students aware of various issues like weak random number generation, Information leakage, poor usability, and weak or no encryption on data traffic
- Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

Course Outcomes

After completing this course, the student will be able to:

- Differentiate between various software vulnerabilities.
- Software process vulnerabilities for an organization.
- Monitor resources consumption in a software.
- Interrelate security and software development process.

UNIT – I

Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, perform security testing and quality assurance

UNIT – II

Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software

application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

UNIT - III

Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

UNIT – IV

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

UNIT – V

Handle insecure exceptions and command/SQL injection, defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws. Case study of DNS server, DHCP configuration and SQL injection attack.

Suggested Readings:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Course Code	Course Title						Core/Elective
P21PE003CS	**Cyber Security and Digital Forensics**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To learn about cyber crimes and how they are planned.
- To learn the vulnerabilities of mobile and wireless devices.
- To learn about the crimes in mobile and wireless devices.
- Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
- Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
- Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools
- E-evidence collection and preservation, network forensics, and mobile device forensics

Course Outcomes

After Completing This Course, the student will be able to:

- Compare and contrast various cryptographic protocols
- Demonstrate various ethical hacking and system hacking
- Explain the various cyber threats and vulnerabilities.
- Discuss the pseudorandom sequence generators and stream ciphers.
- Design and implement secure applications.
- Computer forensics and digital detective and various processes, policies and procedures.
- Email and web forensics and network forensics.

UNIT-1

Introduction to Cybercrime: Introduction, Cybercrime and Information security, who are cybercriminals, Classifications of Cybercrimes, Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes. Cyber offenses: How criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT-2

Cybercrimes and Cyber security: the Legal Perspectives Introduction, Cyber Crime and Legal Landscape around the world, Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario In India, Digital signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT-3

Digital forensics fundamentals: Forensics science, digital forensics, Digital Forensics Science. The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody concept, Network Forensics, Approaching a computer, Forensics Investigation, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing.

UNIT-4

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT-5

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Web Forensics. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

Suggested Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu, J. David Irwin. CRC Press T & F Group.
3. John Sammons, The Basics of Digital Forensics, Elsevier
4. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications.

Suggested Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC
2. Marjie T. Britz, "Computer Forensics and Cyber Crime An Introduction", 3rd Edition, Pearson Education 2013.

3. Cory Altheide, Harlan Carvey, “Digital Forensics with Open Source Tools”, Elsevier Publications, 2011.
4. Brian Carrier, “File System Forensic Analysis”, Pearson Education, 2005.
5. Kevin Mandia, Chris Prosise, “Incident Response and computer forensics”, TataMc Graw Hill, 2006.

Online Resources:

6. https://www.cs.nmt.edu/~df/lectures.html
7. http://www.cyberforensics.in/
8. https://www.ncdrc.res.in/

Course Code	Course Title						Core/Elective
P21PE010CS	**ADVANCED COMPUTER NETWORKS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Learn the division of network functionalities into layers with advance standards.
- Be familiar with the components required to build different types of networks and protocol
- Understand the knowledge of software defined networks.

Course Outcomes:

- Explore the basics of Computer Networks and various protocols.
- Summarize the ATM protocol operation, B-ISDN protocol.
- Elaborate network function virtualization and network virtualization.
- Acquire the knowledge of SMDS data services and ITU recommendation.

UNIT 1:

Internet architecture and performance modeling, Applications - architectures and examples, Transport protocols - TCP mechanics, congestion control, resource allocation, Internet routing, routing algorithms, BGP, advanced routing concepts, router architectures, Link layer: switching, multiple access, MPLS,
Advanced topics: network virtualization, software defined networking

UNIT 2:

Hardware selection in the design process, SONET/SDH standards, Dense wavelength division multiplexing (DWDM), Performance and Design considerations

UNIT 3:

ATM: ATM networking basics, Theory of operations, B-ISDN protocol reference model, PHY layer, ATM layer(Protocol model), ATM layer and cell (Definition), Traffic descriptors and parameters, Traffic and Congestion control defined, AAL Protocol model, Traffic Contract and QoS, User plane overview, Control plane AAL, Management plane,Sub-DS3 ATM, ATM public services.
Layer 2 Switching: Before Layer 2 Switching, Switching Services, Spanning Tree Protocol (STP), LAN Switch-Types

UNIT 4:

INFORMATION THEORY: Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit, Hamming Code, Cyclic Code, Convolution Code, LDPC Code.

UNIT 5:

Introduction to the Cisco IOS The Cisco Router User Interface, Command Line Interface (CLI), Router and Switch Administrative Functions, Router Interfaces, Viewing, Saving, and Erasing Configurations

Suggested Text Books:

1. Behrouz A. Forouzan, Data Communications and Networking, Fourth Ed., Tata McGraw Hill
2. A. Tanenbaum, Computer Networks, PEARSON, 2013
3. James F. Kurose, Keith W. Ross, Computer Networking A Top down Approach, 7th Edition, Pearson, 2001.
4. R. Bose, "Information Theory, Coding and Cryptography", TMH 2007
5. CCNA Intro – Study Guide – Todd Lammle, Sybex

References TEXTBOOKS:

1. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
2. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
3. Amitabha Bhattacharya, "Digital Communication", TMH 2006
4. Larry Peterson and Bruce S Davis "Computer Networks :A System Approach" 5 th Edition , Elsevier -2014
5. Douglas E Comer, " Internet working with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI – 2014.
6. Advance Computer Network, By Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, Wiley India

Course Code	Course Title						Core/Elective
P21PE017CS	**Artificial Neural Networks**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

The objective of this course is to introduce students

- To various neural network architectures and the associated learning paradigms such as perceptron's, multilayer perceptron's, radial basis function networks, support vector machines.
- Regularization networks, and self organizing networks.
- Students will realize that the connecting thread in all these learning structures is to map the adaptation of various parameters as a non-linear optimization.

Course Outcomes:

At the end of the course students will be able to solve real-world problems such as

- Pattern classification as a non-linear feature space partitioning either by estimating the feature space density or by using the feature vectors that lie at the class boundaries.
- Input-output functional mapping and then using these as universal approximations for computing outcomes for the inputs that are unseen.
- Topological mapping of input features to codebook vectors through self-organizing maps.

Unit 1:

Introduction: What is Neural Networks? Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Learning Processes: Learning with a Teacher, Learning Without a Teacher: Reinforcement Learning and Unsupervised Learning, Learning Tasks

Rosenblatt's Perceptrons: Introduction, Perceptron, Perceptron Convergence Theorem, The Batch Perceptron Algorithm .

Unit 2:

Multi-Layer Perceptrons: Preliminaries, Batch Versus On-line Learning, Back-Propagation Algorithm, Summary of BP Algorithm, Heuristics for making BP Algorithm Perform better, Virtues and Limitations of BP Learning, Supervised Learning viewed as an Optimization Problem.

Unit 3:

Radial-Basis Function Networks: Introduction, Cover's Theorem, Interpolation Problem, Radial Basis Function Networks, KMeans Clustering, Recursive Least-Squares. Estimation of the weight vector, Hybrid learning procedure for RBF Networks, Interpretations of Gaussian Hidden Units, Kernel regression and its relation to RBF Networks.

Unit 4:

Regularization Networks: Introduction, Hadamard's conditions for well-posedness, Tikhonov's Regularization Theory, Regularization Networks, Generalized Radial-Basis-Function networks

Unit 5:

Self-Organizing Maps: Introduction, Two Basic Feature mapping Models, Self-Organizing Maps, Summary of Self organizing Algorithm, Properties of Feature Map, Contextual Maps Hierarchical Vector Quantization, Kernel Self-Organizing Map. Relationship between Kernel SOM and Kullback Leibler Divergence

Reference Text:

1. Simon Haykin, Neural Networks and Learning Machines: Eastern Economy Edition, Third Edition, 2009.
2. Jacek M. Zurada, Introduction to Artificial Neural Systems, West Publishing Company.
3. Artificial Neural Networks - B. Vegnanarayana Prentice Hall of India P Ltd 2005
4. Neural Networks in Computer Inteligance, Li Min Fu MC GRAW HILL EDUCATION 2003
5. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.

Course Code	Course Title						Core/Elective
P21PE809CS	**Data Science using R lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**50**	-	**1**

Course Objectives:

- To make students understand learn about a Big Data – R Programming, way of solving problems.
- To teach students to write programs in Scala to solve problems.

Course Outcomes

After completing this course, the student will be able to:

- Write programs in Scala, R to solve problems.

1. Write an R program that uses functions to add n numbers reading from keyboard
2. Write an R program uses functions to swap two integers.
3. Write an R program that use both recursive and non-recursive functions for implementing the Factorial of a given number, n.
4. Write an R program to reverse the digits of the given number {example 1234 to be written as 4321}
5. Write an R program to implement (i)Linear search (ii) Binary Search.
6. Write an R program to implement (i)Bubble sort (ii) selection sort.
7. Write a R program to implement the data structures
   (i) Vectors (ii) Array (iii) Matrix (iv) Data Frame (v) Factors
8. Study and Implementation data transpose operations in R
9. Data Manipulation with dplyr package.
10. Write a R program to implement scan(), merge(), read.csv() and read.table() commands.
11. Write an R program to implement "Executing Scripts" written on the note pad, by calling to the R console.
12. Write a R program, Reading data from files and working with datasets
    (i) Reading data from csv files, inspection of data.
    (ii) Reading data from Excel files.
13. Write a R program to implement Graphs
    (i) Basic high-level plots
    (ii)Modifications of scatter plots
    (iii) Modifications of histograms, parallel box plots.

Course Code	Course Title						Core/Elective
P21PE801CS	**Advanced Machine Learning Using Python Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**50**	-	**1**

Course Outcomes

After Completing This Course, the student will be able to:

- Capture data from different types of Datasets
- Implement Various Algorithms For Data Analysis
- Implement various algorithms based on required user requirements

List of Experiments:

1. Implement and demonstrate the use of a set of training data samples. Read the training data from a .CSV file.
2. Write a program to demonstrate the working of the decision tree based **ID3 algorithm.** Use an appropriate dataset for building the decision tree and apply this knowledge to classify new samples.
3. Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate datasets.
4. Write a program to implement the **naïve Bayesian classifier** for a sample training datasets to reduce.CSV file. Compute The Accuracy of the classifier, considering few test data sets.
5. Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your dataset.
6. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
7. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means **algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
8. Write a program to implement **k-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select Appropriate Data Set For Your Experiment and draw graphs.

Course Code	Course Title						Core/Elective
P21PE802 CS	**Internet of Things Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**50**	**-**	**1**

Course Objectives

- Identify the vision and understand the basics of IoT
- Impart necessary and practical knowledge over various components of IoT
- Develop skills required to build real-time IoT based projects

Course Outcomes

On successful completing of the course, the student will be able to

- Understand IoT's hardware and software components
- Interface I/O devices, sensors & communication module
- Analyze the use of communication protocols in IoT
- Remotely monitor data and control devices.
- Develop real time IoT projects

LIST OF EXPERIMENTS

The following list of experiments are common for micro-controller/micro-processor based IoT development boards. It is suggested to practice the experiments in a simulated environment before handling real time components to avoid unnecessary wear and tear.

1. Setting up the software development environment for the IoT development board.
2. Controlling physical entities (Eg. light, sound etc..) by interfacing with actuators
3. Capturing environment variables (Eg. temperature, light etc..) by interfacing with sensors
4. Integrating sensor and actuator logic for building a simple control system
5. Controlling IoT physical entities using a Smart-Device by establishing a local network
6. Viewing IoT sensor data on Smart-Device by a establishing a local network
7. Setting up a simple Cloud Server and API (UI, middleware and database)
8. Controlling physical entities using IoT via internet using a Cloud Server API
9. Capturing IoT sensor data at a Cloud Server API and presenting sensor values on a UI
10. Data visualization (Eg. charts/graphs) of IoT sensor data bya Cloud Server for UI
11. Integrating IoT devices via Cloud Server API for automation

Suggested additional experiment for micro-processor based IoT development boards only:-

- *Developing an Edge Server (HTTP/MQTT based) for handling loca lIoT devices*

Suggested Reading

1. Arshdeepbahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press 2014
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A Practical Approach”, ETI Labs

Suggested MOOCs

1. Arduino– offered by IIT-B Spoken Tutorial
2. Getting Started with Raspberry Pi – offered by The Geek University
3. Programming with Raspberry Pi – offered by Udemy

Suggested Software/Tools:

- *Simulators: CISCO Packet tracer, TinkerCAD, Wokwi, MicroPython, Wyliodrin, Proteus, UNED*
- *Cloud Services: Blynk, Thingspeak,Heroku, AwardSpace, PythonAnyWhere.*

Course Code	Course Title						Core/Elective
P21PE804 CS	**SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING LAB**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**50**	-	**1**

Course Objectives:

- To make students aware of various issues like weak random number generation, information leakage,
- poor usability, and weak or no encryption on data traffic.
- Techniques for successfully implementing and supporting network services on an enterprise scale and
- heterogeneous systems environment.
- Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

Course Outcomes: On Successful completion of the course, students will be able to

- Develop a security model for any enterprise based application on its threats and vulnerabilities.
- Implement methodologies and tools to design secure software enterprise application.
- Compare different types of threats and attacks.
- Implement the various security algorithms to be implemented for secured computing and computer networks.
- Evaluate various methods of authentication and access control for web-based applications.
- Analyze and apply different anti-intrusion techniques.

List of Experiments:

1. Study of multi-tier software environment.
2. Study of web servers / web browser and Tools for enterprise software Development and deployment.
3. Develop a package using JDBC
4. Develop a package using servlets / JSP.
5. Study of System threat attacks - Denial of Services.
6. Implementation of S-DES algorithm for data encryption.
7. Implementation of Asymmetric Encryption Scheme – RSA.
8. Study of Symmetric Encryption Scheme – RC4.
9. Study of Techniques uses for Web Based Password Capturing.
10. Study of Anti-Intrusion Technique – Honey Pot.

Suggested Bookss:

1. Paul J Perrone, Venkata S.R. Krishna R and Chayanti, “Building Java Enterprise Systems with J2EE”, Techmedia , New Delhi, 2000.
2. George Reese, “ Database programming, with JDBC and Java” Second Edition, O’ReiliyPublishers, New Delhi, 2000.

Course Code	Course Title						Core/Elective
P21PE803 CS	**Cyber Security and Forensics Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	50	-	**1**

Course Outcomes

After Completing This Course, the student will be able to:

- Understand The Applications Of client server.
- Apply various algorithms for diverse problems and measure the performance of various algorithms.

List of lab Experiment

1. Write a Client-Server Program where a client sends a text message to server and server sends the text message to client by changing the case (upper case and lower case) of each character in the message.
2. Write a Client-Server program to implement following classical encryption techniques.
    a. Ceaser Cipher
    b. Transposition Cipher
    c. Row Substitution Cipher
    d. Hill Cipher
3. Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric , Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security and Management.
4. Perform an experiment to demonstrate how to sniff for router traffic by using the tool wire shark.
5. Using NMAP 1) find open ports on a system. 2) Find the machines which are active
6. Find the version of remote OS on the other systems.
7. Find the version of s/w installed on another system.
8. Set Up a honey pot and monitor the honey pot on the network.
9. Write a script or code to demonstrate SQL injection attacks.
10. Create a social networking website login page using Phishing techniques.
11. Write a code to demonstrate dos attacks.
12. Install rootkits and analyse a variety of options.

TEXT BOOKS:

1. "Computer Forensics and Investigations", Nelson, Phillips Enfinger, Steuart, 3rd Edition, Cengage Learning.
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC
3. Marjie T. Britz, "Computer Forensics and Cyber Crime An Introduction", 3rd Edition, Pearson Education 2013.
4. Cory Altheide, Harlan Carvey, "Digital Forensics with Open Source Tools", Elsevier Publications, 2011.
5. Brian Carrier, "File System Forensic Analysis", Pearson Education, 2005.
6. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", TataMc Graw Hill, 2006.

Course Code	Course Title						Core/Elective
P21PE810CS	**Advanced Computer Network Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**2**	**50**	-	**1**

Course Outcomes

After Completing This Course, the student will be able to:

- Analyse wireless LAN technologies
- Understand internet traffic and plan traffic engineering including IP over ATM and multimedia over internet
- Design of routing and transport layer protocols for advanced multi hop networks

List of Lab Experiments

1. Packet Tracer - Packet Switching Simulation.
2. Observe different characteristics of TCP and UDP on different delay using ns2 for wireless network
3. Observe different characteristics of TCP and UDP on different error module using ns2 for wireless network
4. Implement AODV protocol using ns2.
5. Identify the different parameters, delivery ratio, delay, jitter, packet loss ratio for AODV and DSDV protocols using ns2.
6. Implement MAODV protocol using ns2.
7. Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands.
8. Configure, implement and debug the following: Use open-source tools for debugging and diagnostics.
    a. ARP/RARP protocols
    b. RIP routing protocols
    c. BGP routing
    d. OSPF routing protocols
9. Configure STP in Cisco packet tracer.

Textbooks:

1. Advance Computer Network, By Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, WileyIndia
2. CCNA Intro – Study Guide – Todd Lammle, Sybex

Reference Books:

1. High-Speed Networks and Internets, Performance and Quality of Service, Second Edition, William Stallings, Pearson

Course Code	Course Title						Core/Elective
P21PE812CS	CLOUD COMPUTING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
		T	D	P			
-		-	-	2	50	-	1

Course Objectives:

- Understand the working principles of virtualization and hypervisors
- Process of deploying applications in a cloud environment
- Design and development process involved in creating a cloud-based application
- Learn how to simulate a cloud environment.

Course Outcomes:

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

- Configure various hypervisors for virtualization
- Design and deploy a web application in a cloud environment.
- Use a generic cloud environment.
- Perform research using cloud simulators

LIST OF EXPERIMENTS

1. Virtualize different types of machine images over different hypervisors
2. Vertical & Horizontal scaling of a machine image
3. Investigate different kinds of cloud service models
4. Build a simple website using a cloud provider
5. Deploy cloud-based applications onto a web server
6. Provisioning & managing instances on a cloud
7. Centrally control cloud security credentials via Identity and Access Management (IAM).
8. Build a Virtual Private Cloud (VPC)
9. Operate cloud storage mechanisms
10. Build a cloud database server that can be interacted via an app
11. Auto-Scaling and Load Balancing instances on the cloud
12. Working with cloud simulators

Suggested Books:

1. About Hypervisors, Virtualization & Containerization - https://www.ibm.com/in-en/cloud/learn/virtualization-a-complete-guide
2. VMWare Hands-on Labs - https://hol.vmware.com/
3. Cloud Sim - http://cloudbus.org/cloudsim/
4. Cloud Sim Plus - https://cloudsimplus.org/

Course Code	Course Title						Core/Elective
P21PE018CS	**Cryptography and Network Security**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To Learn About The Threats Of Network Security.
- To understand what causes these threats by studying how vulnerabilities arise in the development and uses of computer systems.
- To narrate and evaluate the design principles of conventional encryption and decryption techniques.
- To analyse the concepts of public key encryption and public key algorithm.
- To learn the emerging concepts of cryptography and algorithms
- To defend the security attacks on information systems using secure algorithms and Authentication process
- To categorize and analyze the key concepts in network and wireless security

Course Outcomes

After completing this course, the student will be able to:

- Analyseanddetermineforanyorganizationthesecurityrequirementsandappropriatesolutions.
- Analyze the cryptographic algorithms for information security.
- Protect system from different types of threats, malicious software vulnerabilities and attacks.
- Describe symmetric and public key encryption algorithms like DES, AES, RSA etc.
- Identify ethical, professional responsibilities, risks and liabilities computer and network environment, and best practices to write security policy.
- Distinguish and analyse available network and protocols such as SSL, IPSes, TLS, etc.
- Narrate the Authentication Of Digital Certificates.
- Differentiate MAC and hashing techniques needed for authentication.

UNIT :1

Introduction and Symmetric Key: Introduction to Cryptography, Types of Attacks, Symmetric Key Cryptography, Data Encryption Standard (DES), Differential and Linear cryptanalysis, Advanced Encryption Standard(AES), Modes of operation, Stream Ciphers: Feedback shift registers, Stream ciphers based on LFSRs.

UNIT 2 :

Asymmetric Key Cryptosystems: Applications of asymmetric Cryptosystems –RSA Rabin, Elgamal, Probabilistic Cryptosystems, Elliptic Curve Cryptography (ECC), Diffie-Hellman key exchange protocol, Chinese Remainder Theorem (CRT).

UNIT 3:

Data Integrity and Authentication: Message Authentication Code (MAC), Hash function properties, General model for iterated hash functions -MD5, Secure Hash algorithms, HMAC, Attacks on hash functions, Digital Signatures, X. 509 digital certificate, Kerberos, Zero-Knowledge Protocol

UNIT 4:

Electronic Mail Security: Distribution lists, Establishing keys, Privacy, source authentication, message integrity, Nonrepudiation, Proof of submission, Proof of delivery, Message flow confidentiality, anonymity, Pretty Good Privacy (PGP), S/MIME
Firewalls and Web Security: IPsec: AH and ESP, IKE- SSL/TLS, Secure Shell (SSH) application-OpenSSL, Packet filters, Application-level gateways, Intrusion detection and Prevention systems

UNIT 5:

Wireless Security: Attacks in wireless networks: DoS and DDo Sattacks, Security issues and challenges in WSN and IOT, Wireless Application Protocol (WAP), Wireless LAN Security, Security in GSM.

Suggested Text Book (s)

1. J. Katz and Y. Lindell, Introduction to Modern Cryptography. Chapman & Hall/CRC Press,2014
2. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed.Pearson Publishers, 2017.
3. Behrouz A. Forouzan, Cryptography and Network Security:6th Ed. McGraw-Hill,2017
4. Douglas E Comer, “Internetworking with TCP/IP, Principles, Protocols and Architecture” 6th Edition, PHI - 2014
5. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks 5th Edition, Pearson
6. Data and Computer Communications. Eighth Edition. by William Stallings.
7. WiMAX Security and Quality of Service: An End-to End Perspective, ISBN: 978-0-470-72197-1, Wiley publication

Reference Books:

1. Kaufman, Perlman and Speciner. Network Security: Private Communication in a Public
   World., 2nd edition,2002, Pearson Publishers (ISBN No.:978-01-3-04601-96)
2. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied
   Cryptography,5th edition,2001, CRC Press,(ISBN No:0-8493-8523-7)
3. D. R. Stinson, Cryptography: Theory and Practice, 3rd Ed. Boca Raton, FL: Chapman & Hall/CRC, 2005. (ISBN No.:978-1-58-488508-5)J. H. Silverman, A Friendly
4. Philip N. Klein, "A Cryptography Primer-Secrets and Promises", ISBN 9781107603455,
   Cambridge University Press, 2014
5. Data communications and Networking, Behrouz A Forouzan, Tata Mc Graw-Hill 5th edition, 2013

Course Code	Course Title						Core/Elective
P21PE005CS	**Natural language processing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Teach students the leading trends and systems in natural language processing.
- Make them understand the concepts of morphology, syntax and semantics of the language and that they are able to give the appropriate examples that will illustrate the above-mentioned concepts.
- Teach them to recognize the significance of pragmatics for natural language understanding.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic and semantic processing.

Course Outcomes

After Completing This Course, the student will be able to:

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule-based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.
- Perform various language phonetic analysis

Unit-1

Introduction and Basic Text Processing, What Do We Do in NLP ,Why is NLP hard ,Empirical Laws ,Text Processing: Basics Spelling Correction, Language Modeling, Spelling Correction: Edit Distance ,Weighted Edit Distance, Other Variations , Noisy Channel Model for Spelling Correction ,N-Gram Language Models ,Evaluation of Language Models, Basic Smoothing

Unit-2

Advanced smoothing for language modeling, POS tagging, Language Modeling: Advanced Smoothing Models ,Computational Morphology ,Finite - State Methods for Morphology , Introduction to POS Tagging ,Hidden Markov Models for POS Tagging

Models for Sequential tagging – Max Ent, CRF, Viterbi Decoding for HMM, Parameter Learning, Baum Welch Algorithm, Maximum Entropy Models, Conditional Random Fields Syntax – Constituency Parsing, Syntax–Introduction, Syntax– Parsing, Syntax - CKY, PCFGs PCFGs - Inside-Outside Probabilities

Unit-3

Dependency Parsing: Dependency Grammars and Parsing - Introduction, Transition Based Parsing: Formulation, Transition Based Parsing: Learning, MST-Based Dependency Parsing ,MST-Based Dependency Parsing : Learning

Distributional Semantics: Distributional Semantics - Introduction, Distributional Models of Semantics, Applications, Structured Models, Word Embeddings Lexical Semantics: Lexical Semantics - Wordnet ,Word Sense Disambiguation ,Novel Word Sense detection

Unit-4

Topic Models : Introduction ,Latent Dirichlet Allocation : Formulation ,Gibbs Sampling for LDA, Applications ,LDA Variants and Applications Entity Linking, Information Extraction, Entity Linking ,Information Extraction –Introduction, Relation Extraction, Distant Supervision

Unit-5

Text Summarization, Text Classification.
Text Summarization - LEXRANK, Optimization based Approaches for Summarization, Summarization Evaluation .
Text Classification: Sentiment Analysis and Opinion Mining, Sentiment Analysis - Introduction
Sentiment Analysis - Affective Lexicons, Learning Affective Lexicons ,Computing with Affective Lexicons ,Aspect - Based Sentiment Analysis

Suggested Text Books:

1. Speech and Language Processing ,2nd Ed,Dan Jurafsky and James H. Martin
2. Foundations of Statistical Natural Language Processing - Christopher D. Manning

Course Code	Course Title						Core/Elective
P21PE007CS	**Distributed Databases**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database systems along with object oriented models

Course Outcomes

After Completing This Course, the student will be able to:

- Understand Relational Database Management Systems,
- Normalization to make efficient retrieval from database and query.

UNIT-I

Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs,Complicating factors and Problem areas in DDBMSs, Overview of Relational DBMS Relational Database Concepts, Normalization, Integrity Rules, Relational Data Languages, Relational DBMS.

UNIT-II

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control.

UNIT-III

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing Introduction Transaction Management: Definition of Transaction, Properties Of Transaction, types of transaction. Distributed Concurrency Control: Serializability Theory, Taxonomy Of Concurrency Control Mechanisms, locking based concurrency control algorithms

UNIT-IV

Parallel Database Systems: Database servers, Parallel Architecture, Parallel DBMS techniques, Parallel Execution Problems, Parallel execution for hierarchical architecture

UNIT-V

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing. Recent approaches, models and current trends in improving the performance of Distributed Database

Suggested Books:

1. Principles of Distributed Database Systems, Second Edition, M.Tamer Ozsu Patrick Valduriez
2. Distributed Databases Principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata Mc Graw Hill.

Course Code	Course Title						Core/Elective
P21PE013CS	**Soft Computing and Techniques**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To Implement Soft Computing Based Solutions For Real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide student and on experience MATLAB to implement various strategies.

Course Outcomes

After Completing This Course, the student will be able to:

- Identify and describes of the computing techniques and their roles in building intelligent machines
- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate and compare solutions by various soft computing approaches for given problem.

UNIT-I

Introduction to Soft Computing and Neural Networks: Evolution of Computing : Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

UNIT-II

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT-III

Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architecture, Advances in Neural networks

UNIT-IV

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

UNIT-V

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study Of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic. Recent Trends in deep learning, various classifiers, neural networks and genetic algorithms. Implementation Of recently proposed soft computing techniques.

Suggested Books:

1. J.-S.R.Jang,C.-TSun,E.Mizutani, Neuro-Fuzzy and Soft Computing, Pearson Education, 2015.
3. GeorgeJ.Klir and BoYuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall,1995.
4. MATLABToolkitManual

Course Code	Course Title						Core/Elective
P21PE012CS	**Cloud Computing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To discuss the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges.
- The basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations.
- Different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS);
- Cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage.
- The variety of programming models and develop working experience in several of them

Course Outcomes

After completing this course, the student will be able to:

- Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
- Apply fundamental concepts in cloud infrastructures to understand the trade-offs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications that are resilient, elastic and cost-efficient.
- Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
- Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
- Analyze various cloud programming models and apply them to solve problems on the cloud

UNIT-I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

UNIT-II

Scaling in the Cloud, Capacity Planning, Load Balancing, File System and Storage

UNIT-III

Multi-tenant Software, Data in Cloud, Database Technology, Content Delivery Network, Security Reference Model, Security Issues, Privacy and Compliance Issues

UNIT-IV

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT-V

Enterprise architecture and SOA, Enterprise Software, Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Books:

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "*Distributed and Cloud Computing from Parallel Processing to the Internet of Things*", Elsevier, 2012.

Course Code	Course Title						Core/Elective
P21PE008CS	**Software Project Management**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To highlight the importance of software project management.
- To discuss various processes in Software Project Management.
- To Provide Tools And Techniques For Project Monitoring.
- To Expose To Different Project Management Lifecycles.

Course Outcomes

After completing this course, the student will be able to:

- Design a project management plan using different project management lifecycles.
- Acquire the ability to track project execution.
- Analyse The Risks Associated With The Projects

UNIT-I

Conventional Software Management, Evolution of Software Economics, Improving Software Economics, Old Way & New.

UNIT-II

Life – Cycle phases, Artifacts of the process, Model Based Software Architectures, Workflows of the Process, Checkpoints of the process.

UNIT-III

Iterative Process Planning, Project Organizations & Responsibilities, Process Automation, Project Control of Process Instrumentation, Tailoring the Process.

UNIT-IV

Modern Project profiles, Next Generation Software Economics, Modern process Transitions, Managing Contacts, Managing People & Organizing Terms.

UNIT-V

Process improvement & mapping to the CMM, ISO 12207 – an overview, programme management.

Suggested Books:

1. Walker Royce, *Software Project Management – A Unified frame work,* Pearson Education, Addison, 1998, Sixth Printing November 2000
2. Bob Hughes and Mike Cotterell, *Software Project Management*, Tata McGraw Hill, 3rd Edition, 2010.
3. Watt.S. Humphery, *Managing Software Process,* Addison - Wesley, 2008.

Course Code	Course Title						Core/Elective
P21PE015CS	**Software Architecture and Design Pattern**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives: The main objective is

- To introduce the student to architecture of software and design Patterns. Upon completion of this course the student will Get an idea on envisioning architecture, creating an architecture, analyzing architecture. Understand the creational and structural patterns.
- Be capable of applying his knowledge to create an architecture for given application.
- Be able to explain the role of analyzing architectures.
- Be able to identify different structural patterns.

Course Outcomes: At the end of the course the student will be able to Understand the architecture, creating it and moving from one to any, different structural patterns.

- Analyze the architecture and build the system from the components.
- Design creational and structural patterns.
- Learn about behavioral patterns.
- Do a case study in utilizing architectural structures.

UNIT- I

Envisioning Architecture: The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Creating an Architecture: Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

UNIT -II

Analyzing Architectures: Architecture Evaluation, Architecture design decision making, ATAM, CBAM. Moving from one system to many: Software Product Lines, Building systems from off the shelf components, Software architecture in future.

UNIT-III

Patterns: Pattern Description, Organizing catalogs, role in solving design problems Selection and usage. Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy.

UNIT- IV

Behavioral patterns: Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.

UNIT -V

Case Studies: A-7E – A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development

Text Books:

1. Len Bass, Paul Clements & Rick Kazman, Software Architecture in Practice, 2nd Edition, Pearson Education, 2003.
2. Erich Gamma, Design Patterns, 1st Edition, Pearson Education,1995.

Suggested Books:

1. Luke Hohmann , Beyond Software architecture, Addison wesley, 2003.
2. David M. Dikel, David Kane and James R. Wilson, Software architecture, 1st Edition, Prentice Hall,2001
3. F.Buschmann , Pattern Oriented Software Architecture, Wiley&Sons,1st Edition,2001

Web references :

http://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Arc hitecture / Design_Patterns.

Course Code	Course Title						Core/Elective
	Mobile Computing						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To impart fundamental awareness of mobile hardware device's structure and strategies along with basic concepts of mobile computing.
- Illustrate concepts of broad systems along with various mobile communications architectures.
- PerceptiontowardsvariousconceptsIEEE802.11andBluetootharchitectures.
- Understand of MobileIP, concepts of routing protocols in MANET and Classical TCP improvements.
- Learnfilesystemsupportformobilityandmobiletransactionsandcommerce.

Course Outcomes

After Completing This Course, the student will be able to:

- Understandcharacteristicsandlimitationsofmobilehardwaredevicesincludingtheiruser-interfacemodalities.
- Identify important issues of GSM, Satellite systems GPRS for mobile communications and broadcast systems.
- Demonstrate knowledge of WLAN, IEE802.11 and Bluetooth architectures and protocols
- Motivate the need for Mobile IP, Mobile Adhoc Networks, and configuring hosts using DHCP, Traditional TCP and Classical TCP improvements and WEB architectures
- Enumerate various data Dissemination Mechanisms And Mobile Transaction Models

UNIT-I

Introduction: Wireless Transmission, Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulations, Spread Spectrum, MAC, SOMA, FDMA, TDMA, CDMA, Cellular Wireless Networks.

UNIT-II

Telecommunication Systems: GSM, GPRS, Satellite Networks, Basics, Parameters and Configurations, Capacity Allocation, FAMA and DAMA, Broadcast Systems, DAB, DVB, CDMA and 3G.

UNIT-III

Wireless LAN: IEEE 802.11 Architecture, Services, MAC – Physical Layer, IEEE 802.11a – 802.11bstandards, Bluetooth.

UNIT-IV

Routing Ad-hoc Network Routing Protocols: Ad-hoc Network Routing Protocols, Destination Sequenced Distance Vector Algorithm, Cluster Based Gateway Switch Routing, Global State Routing, Fish-eye state Routing, Dynamic Source Routing, Ad-hoc on-demand Routing, Location Aided Routing, Zonal Routing Algorithm.

MobileIP- Dynamic Host Configuration Protocol.

Traditional TCP- Classical TCP Improvements–WAP, WAP2.0.

UNIT-V

Publishing & Accessing Data in Air: Pull and Push Based Data Delivery models, Data Dissemination by Broadcast, Broadcast Disks, Directory Service in Air, Energy Efficient Indexing scheme for Push Based Data Delivery.

File System Support for Mobility: Distributed File Sharing for Mobility support, Coda and other Storage Manager for Mobility Support.

Mobile Transaction and Commerce: Models for Mobile Transaction, Kangaroo and Joey transactions, Team Transaction, Recovery Model for Mobile Transactions, Electronic Payment and Protocols for Mobile Commerce.

Suggested Books:

1. JochenSchiller, *Mobile Communications*, Pearson Education, 2nd Edition, 2009.
2. Kurnkum Garg, *Mobile Computing*, Pearson Education,2010
3. Asoke K Talukder, Roopa R Yavagal, *Mobile Computing*, TMH 2008.
4. Raj Kamal, *Mobile Computing*, Oxford, 2009.
5. "*A Survey of Mobile Transactions appeared in Distributed and Parallel Databases*"1 6,193-230,2004, Kluwer Academics Publishers.
6. S.Acharya, M.Franklinand S.Zdonil, "*Balancing Push and Pull for Data Broadcast, Proceedings of the ACM SIGMOD*", Tuscon, AZ, May 1997.
7. S.Acharya, R.Alonso, M.Franklinand S.Zdonik, "*Broadcast Disks: Data Management for Asymmetric Communication Environments, Proceedings of the ACM SIGMOD Conference*", SanJose, CA, May 1995.

Course Code	Course Title						Core/Elective
P21PE016CS	**Software Quality and Testing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the importance of Software Quality
- Understand the use of various tools and approaches in software Quality
- Understand a range of different Software Testing Techniques and Strategies.
- Able to apply a specific (automated) unit testing methods.

Course Outcomes

After completing this course, the student will be able to:

- Use the various methodologies for assuring quality.
- Build a tool for any testing methodology.
- Select appropriate methodology for testing of a particular task

UNIT – I

The Software Quality Challenge, Introduction Software Quality Factors, The Components of the Software Quality Assurance System – Overview, Development and Quality Plans.

UNIT – II

Integrating Quality Activities in the Project Life Cycle, Assuring the Quality of Software Maintenance Components, CASE Tools and their effect on Software Quality, Procedure and Work Instructions, Supporting Quality Devices, Configuration Management, Documentation Control, Project Progress Control.

UNIT – III

Software Quality Metrics, Costs of Software Quality, Quality Management Standards - ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma, SQA Project Process Standards – IEEE Software Engineering Standards**.**

UNIT – IV

Building a Software Testing Strategy, Establishing a Software Testing Methodology, Determining Your Software Testing Techniques, Eleven – Step Software Testing Process Overview, Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report Test Results, Test Software Changes, Evaluate Test Effectiveness.

UNIT – V

Testing Client / Server Systems, Testing the Adequacy of System Documentation, Testing Web-based Systems, Testing Off – the – Shelf Software, Testing in a Multiplatform Environment, Testing Security, Testing a Data Warehouse, Creating Test Documentation, Software Testing Tools, Taxonomy of Testing Tools, Methodology to Evaluate Automated Testing Tools, Load Runner, Win Runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

Suggested Readings:

1. Daniel Galin, *Software Quality Assurance – From Theory to Implementation*, Pearson Education.2004
2. Mordechai Ben – Menachem / Garry S. Marliss, *Software Quality – Producing Practical, Consistent Software*, BS Publications, 2014
3. William E. Perry, *Effective Methods for Software Testing*, 2nd Edition, Wiley.
4. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing, Principles and Practices*, Pearson Education, 2006.
5. K.V.K.K. Prasad, *Software Testing Tool*, Wiley Publishers.

Web Resources:

1. http://www.sei.cmu.edu/cmmi/
2. java-source.net/open-source/testing-tools
3. www.junit.org
4. https://jmeter.apache.org/usermanual/get-started.html
5. https://www.selenium.dev/documentation/

Course Code	Course Title						Core/Elective
P21PE019CS	**ADHOC & WIRELESS SENSOR NETWORKS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the concept of mobile adhoc networks, design and implementation issues and available solutions.
- Demonstrate the routing mechanisms and three classes of approaches: proactive, on-demand and hybrid.
- Understand the clustering mechanisms and different schemes that have been employed, e.g.,hierarchical.
- Explain sensor networks and their characteristics. This includes design of MAC layer protocols, understanding of power management, query processing and sensor databases.
- Demonstrate the designing and implementing adhoc network functionality using network simulation tools and Pocket PCs.

Course Outcomes

- After Completing This Course, the student will be able to:
- Understand The Concept Of Mobile computing.
- Analyze the GSM architecture, protocols and their new data services.
- Estimate the MAC protocols for GSM and wireless LANs.
- Identify The Collision Avoidance For Protocols.
- Explain about the mobile IP Network layer.
- Classify the transport layer protocols for mobile networks.
- Develop new adhoc network applications and algorithms or protocols.
- Understand and develop any existing or new protocol related to mobile environment.
- Apply The Protocols and Platforms Mobile computing WAP.
- Differentiate the different operating Systems like Palm OS, Windows CE, Symbian OS, Linux for Mobile devices.
- List out the Advanced Technologies for Developing The Mobile networks

UNIT–I

Introduction to Ad Hoc Wireless Networks: Characteristics of MANETS, Applications of MANETS, Challenges

Routing In MANETS: Topology based versus position-based approaches, Topology Based Routing Protocols, and position based routing, other routing protocols.

UNIT–II

Data Transmission In MANETS: The Broadcast Storm, Multicasting, Geo casting.

TCP Over AdHoc Networks: TCP protocol overview, TCP and MANETS, Solutions for TCP over AdHoc

UNIT–III

Basics Of Wireless Sensors And **Applications:** The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications.

Data Retrieval In Sensor Networks: Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs.

UNIT–IV

Security: Security in Ad Hoc Wireless Networks, Key Management, Secure Routing, Cooperation in MANETs, Intrusion Detection Systems

Sensor Network Platforms and Tools: Sensor network Hardware, Sensor Network Programming Challenges, and Node-Level Software Platforms.

UNIT–V

Operating System-Tiny OS: Imperative Language: nesC, Data flow style language: Tiny GALS, Node- Level Simulators, NS-2andits sensors network extension, TOSSIM.

TextBooks:

1. AdHoc and Sensor Networks: Theory and Applications, Carlosde Morais Cordeiro and Dharma Prakash Agrawal, World Scientific Publications/Cambridge University Press,2006.
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005.

References:

1. AdHoc Wireless Networks: Architectures and Protocols, C.Siva Rama Murti n S.Manoj, Pearson Education,2004.
2. Guide to Wireless AdHoc Networks, Sudip Misra, Isaac Woungang and Subhas Chandra Mishra, Springer International Edition,2011.
3. Guide to Wireless Sensor Networks, Sudip Misra, Isaac Woungang, and Subhas Chandra Misra, Springer International Edition,2012.
4. Wireless Mesh Networking, Thomas Kragand Sebastin Buettrich, O'Reilly Publishers, 2007.
5. Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group,2010.

6. Wireless Ad hoc Mobile Wireless Networks-Principles, Protocols and Applications, Subir Kumar Sarkar, et al.,Auerbach Publications, Taylor & FrancisGroup,2008.
7. Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, Taylor & FrancisGroup,2007
8. Wireless Ad hoc and Sensor Networks–Protocols, Performance and Control, Jagannathan Sarangapani, CRC Press, Taylor& FrancisGroup,2007, rp2010.
9. Security in Ad hoc and Sensor Networks, Raheem Beyah, et al., World Scientific Publications /CambridgeUniversityPress,2010

Course Code	Course Title						Core/Elective
P21PE006CS	**Blockchain Technology**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To Introduce Students To understand the fundamentals of Blockchain.
- To Train Students To Illustrate the Technologies of blockchain.

Course Outcomes

After Completing This Course, the student will be able to:

- Define and explain the fundamentals of Blockchain
- Illustrate the technologies of blockchain
- Describe the models of blockchain
- Analyze and demonstrate the Ethereum
- Analyze and demonstrate Hyperledger fabric

UNIT – I

Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collision-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency?

UNIT II

Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc. Bitcoin Blockchain - Wallet - Blocks - Merkle Tree - hardness of mining-transaction verifiability-anonymity-forks-double spending-mathematical analysis properties of Bitcoin. Bitcoin, the challenges, and solutions

UNIT III

Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle-formal treatment of consistency, liveness and fairness-Proof of Stake (PoS)Based Chains – Hybrid models (PoW +PoS).Bitcoin scripting language and their use

UNIT IV

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity – Smart Contracts-The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contract to enforce legal contracts, comparing Bitcoin scripting. Ethereum Smart Contracts. Some attacks on smart contracts

UNIT V

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain. Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance And other Contract Enforcement mechanisms. Limitations of Blockchains a technology and mythsvs. Reality Of Blockchain Technology

REFERENCES:

1. Blockchain Technology: Cryptocurrency and Applications, S.Shukla, M.Dhawan, S.Sharma, S.Venkatesan Oxford University Press 2019
2. Bitcoin and cryptocurrency technologies: A Comprehensive Introduction, Arvind Narayananet. Al. Princeton University Press 2016
3. Research perspectives and challenges for Bitcoin and cryptocurrency, Joseph Bonneau metal, SoK, IEEE Symposium on security and Privacy 2015
4. The bitcoin backbone protocol -analysis applications J.A.Garayetal, EUROCRYPT LNCS VOl 9057, (VOLII), pp281-310 2015
5. Analysis of Blockchain protocol in Asynchronous Networks, R.Passetal, EUROCRYPT,2017
6. Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming' Josh Thompson Create Space Independent Publishing Platform2017.

Course Code	Course Title						Core/Elective
P21MC001CS	**Research Methodology and IPR**						**Mandatory Course**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make students to

- Motivate To Choose Research as Career
- Formulate The Research Problem, prepare the research design
- Identifyvarioussourcesforliteraturereviewanddatacollectionreportwriting
- Equip With Good Methods to Analyse The Collected Data
- Know about IPR copyrights

Course Outcomes

At The End of This Course, students will be able to**:**

- Define research problem, review and asses the quality of literature from various sources
- Improve the style and format of writing are port for technical paper/ Journal report, understand and develop various research designs
- Collect The Data By Various Methods: observation, interview, questionnaires
- Analyse Problem By Statistical Techniques: ANOVA, F-test, Chi-square
- Understand Apply For Patent And Copyrights

UNIT–I

Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods Versus Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT–II

Literature Survey and Report writing: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.

Report Writing: Meaning of interpretation, layout of research report, Types of reports, Mechanism of writing a report. **Research Proposal Preparation**: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

UNIT–III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT–IV

Data Collection and Analysis: Methods Data collection, Data organization, Methods of data grouping, Diagrammatic Representation Of Data, Graphic representation of data. Importance of Parametric, non-parametric test, testing of variance of two normal populations, use of Chi-square, ANOVA, F-test, z-test

UNIT–V

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, The main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of apatent, Licensing, Transfer of technology.

Suggested Books:

1. C.R Kothari, Research Methodology, Methods & Technique‖; New Age International Publishers, 2004
2. R.Ganesan, Research Methodology for Engineers‖, MJPPublishers,2011
3. Y.P.Agarwal,StatisticalMethods:Concepts,ApplicationandComputation‖,Sterling Publications Pvt.Ltd., New Delhi, 2004
4. G.B.Reddy, Intellectual Property Rights and Law5thEd.2005GogiaLawAgency
5. Ajit Parulekar and Sarita D'Souza, Indian Patents Law–Legal & Business Implications, Macmillan India Ltd, 2006

Course Code	Course Title						Core/Elective
P21OE001CE	Cost Management of Engineering projects						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To apply modern software packages to conduct analysis of real-world data.
- To understand the technical under pinning of engineering economic analysis.
- Theabilitytoapplytheappropriateanalyticaltechniquestoawidevarietyofrealworldproblemsanddatasets.
- Tosummarizeandpresenttheanalysisresultsinaclearandcoherentmanner.

Course Outcomes

Attend This Course, students will be able to**:**

- Students should be able to learn the cost concepts in decision making
- Student should be able to do cost planning and Marginal Costing
- Studentsshouldbeabletocreateadatabaseforoperationalcontrolanddecisionmaking.

UNIT-I

Introduction and Overview of the Strategic Cost Management Process: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT-II

Project: meaning, Different Types, when to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as a conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project Site: Data Required with Significance. Project contracts. Types And Contents. Project Execution Project Cost Control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT-III

Cost Behavior and Profit Planning Marginal Costing: Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT-IV

Activity-Based Cost Management: Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V

Quantitative Techniques for cost management: Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Suggested Books:

1. Cost Accounting–A Managerial Emphasis, Prentice Hall of India, New Delhi
2. CharlesT.Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A.Alkinson, Management & Cost Accounting

Course Code	Course Title						Core/Elective
OE9102 CS	Business Analytics						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Understand the role of business analytics within an organization
- Analysedatausingstatisticalanddataminingtechniquesandunderstandrelationshipsbetweentheunderlyingbusinessprocessesof an organization
- Togainanunderstandingofhowmanagersusebusinessanalyticstoformulateandsolvebusinessproblemsandto support managerial decision making
- To become familiar with Processes Need To Develop, report and analyse business data
- Use Decision-making tools/Operations Research Techniques
- Mangebusiness process using analytical and management tools
- Analyse and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.
- Student will able to understand the basic rules of research formulation and procedure for obtaining patent rights

Course Outcomes

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

- Students will demonstrate knowledge of data analytics
- Studentswilldemonstratetheabilityofthinkcriticallyinmakingdecisionsbasedondataanddeepanalytics
- Studentswilldemonstratetheabilitytousetechnicalskillsinpredicativeandprescriptive modellingtosupport business decision-making
- Students will demonstrate the ability to translate data in to clear, actionable in sights

UNIT-I

Business Analytics: Overview of Business analytics, Scope of Business Analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNIT-II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, News vendor Model, Over booking Model, Cash Budget Model.

UNIT-V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without 8 Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in Embedded and collaborative business intelligence, Visual data 4recovery, Data Storytelling and Data journalism.

Suggested Books:

1. Business analytics Principles, Concepts and Applications by Marc J.Schniederjans, Dara G.Schniederjans, Christopher M.Starkey, Pearson FTPress.
2. Business Analytics by James Evans, persons Education.

Course Code	Course Title						Core/Elective
OE9103 EC	Embedded System Design						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Detailed overview of important concepts of Embedded system
- Analyse PICmicro controller, its features and programming
- Describe ARM Micro controller architectural details and instruction set
- Understand ARM Memory management
- Learn the techniques to develop an embedded system and case studies

Course Outcomes

After Completing This Course, the student will be able to:

- Understand The Fundamentals of The Embedded System Design
- EnumeratetheinstructionsetofARMProcessorbystudyingthearchitectureof ARM core
- Acquire Knowledge On The Serial, parallel and network communication protocols.
- Learn the embedded system design life cycle and co-design issues.
- List the various embedded software development tools used in the design of embedded system for various applications.

UNITI

Introduction to Embedded Systems: Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture. Application areas of Embedded System sand Categories of Embedded Systems. Embedded System Design and Co-Design issues and Design Cycle Process

UNIT II

PIC 18: Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18

UNIT III

ARM Architecture: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT IV

ARM Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.

ARM Memory Management: Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

UNITV

Embedded Software Development Tools, Host and Target Machines, Linkers/ Locators for Embedded Software, Getting Embedded Software into the Target System. Debugging Techniques.

Case Studies: Design of Embedded System using Microcontrollers – for applications in the area of communications and auto motives. (GSM/GPRS, CAN, Zigbee)

Suggested Books:

1. Raj Kamal, Embedded Systems–Architecture, Programming and Design, 2nd Edition, TMH,2008.
2. Andrew N.Sloss, Dominic Symes, Chris Wright, ARM Systems Developer's Guides–Designing & Optimizing System Software, Elsevier, 2008.
3. Mazidi, MCK inlay and Danny Causey, PIC Microcontrollers and Embedded Systems, Pearson Education,2007
4. David.E.Simon,AnEmbeddedSoftwarePrimer,1st Edition,PearsonEducation,1999
5. Jonathan W.Valvano, Embedded Microcomputer Systems, Real Time Interfacing, ThomasLearning,1999.

Course Code	Course Title						Core/Elective
OE9104 EE	Waste to Energy						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To enable students to aware about the generation of energy from waste.

Course Outcomes

Attend This Course, students will be able to**:**

- Students should be able to learn the Classification of waste as a fuel.
- Students should be able to learn the Manufacture of charcoal.
- Students should be able to carry out the designing of gasifiers and biomass stoves.
- Student should be able to learn the Biogas plant technology.

UNIT-I

Introduction Energy form Waste: Classification Of Waste as fuel–Agro based, Forest residue, Industrial waste - MSW – Conversion Devices–Incinerators, gasifiers, digestors. Biomass Pyrolysis: Pyrolysis–Types, slow fast–Manufacture of Charcoal–Methods-Yields And Application–Manufacture Pyrolytic Oils Gases, yields and applications.

UNIT-II

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier Engine Arrangement And electrical power–Equilibrium and Kinetic Considerations Gasifier operation.

UNIT-III

Biomass Combustion: Biomass Stoves–Improved Chulhas, types, some exotic designs, fixed bed combustors, Types, inclined grate combustion, Fluidized Bed Combustors, Design, construction, and operation-Operation All the Above Biomass Combustors.

UNIT-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bioenergy system - Design and constructional features - Biomass resources and their classification – Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction

UNIT-V

Biochemical Conversion: Anaerobic Digestion - Types of biogas Plants – **Applications-Alcohol Production** from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme India.

Suggested Books:

1. Non-Conventional Energy, Desai, Ashok V.,Wiley Eastern Ltd.,1990.
2. Biogas Technology-A Practical Handbook, Khandelwal, K.C.and Mahdi, S.S., Vol. I & II, Tata Mc Graw Hill Publishing Co.Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal, D.S., IBH Publishing Co.Pvt.Ltd.,1991.
4. Biomass Conversion and Technology, C.Y.Were Ko-Brobby and E.B.Hagan, John Wiley & Sons,1996.

Course Code	Course Title						Core/Elective
OE9105 ME	Industrial Safety						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Causes for industrial accidents and preventive steps tobe taken.
- Fundamental concepts of Maintenance Engineering.
- About wear and corrosion along with preventive steps to be taken
- The Basic Concepts And Importance Of Fault Tracing.
- The steps involved in carrying out periodic and preventive maintenance various equipment's used industry

Course Outcomes

After Completing This Course, the student will be equipped with:

- concepts of engineering systems safety
- Identify the causes for industrial accidents and suggest preventive measures.
- Identify the basic tools and requirements of different maintenance procedures.
- Apply different techniques to reduce and prevent Wear and corrosion in Industry.
- Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
- Apply periodic and preventive maintenance techniques as required for industrial equipment's like motors, pumps and air compressors and machine tools etc.

UNIT-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety colour codes. Fire Prevention and firefighting, equipment and methods.

UNIT-II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of Maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service Life Of equipment.

UNIT-III

Wear and Corrosion and their prevention: Wear - types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw Down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipments like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling mechanical components, overhauling electric motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps /procedure for periodic and preventive maintenance of: i.Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair Cycle Concept and importance.

Suggested Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, DaInformation Services.
2. Maintenance Engineering, H.P.Garg, S.Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mc Graw Hill Publication
4. Foundation Engineering Hand book, Winter korn, Hans, Chapman & Hall London

Course Code	Course Title				Core/Elective	
AD 9001 HS	**English for Academic and Research Writing**				**Audit I**	
P21	Contact Hours per Week				CIE	SEE	Credits
	L	T	**D**	L			-
-	**2**	**-**	**-**	**2**	**30**	**70**	

Course Objectives:

To learn the Features of Academic Writing

- To write Essays, Reports, Reviews, Abstracts and Proposals
- To demonstrate Academic Writing Skills
- To analyse the Research Process
- To apply appropriate structure to a Research Document

Course Outcomes: At the end of the course, the student should be able to

- Learn the Features, Tone, Style and Ethics pertaining to Academic Writing
- write Essays, Reports, Reviews, Abstracts and Proposals
- demonstrate Academic Writing Skills such as Paraphrasing, Summarizing, Quoting, Rewriting and Expansion
- Analyse the Research Process from Selection of Topic, Formulation of Hypothesis, Collection, Analysis, Interpretation and Presentation of Data
- apply appropriate structure to a Research Document, such as selection of Title, writing the Abstract, Introduction, Literature Survey, Methodology, Discussion,
- Findings/Results, Conclusion and Documenting Sources (IEEE style)

Unit-I

Features of Academic Writing Language**:** Clear, Correct, Concise, Inclusive; Tone: Formal, Objective, Cautious; Style: Appropriate, Accurate, Organized; Ethics: Honesty, Integrity, Responsibility, Accountability

Unit -II

Kinds of Academic Writing Essays, Reports, Reviews, Abstracts, Proposals

Unit - III

Academic Writing Skills Paraphrasing; Summarizing; Quoting; Rewriting; Expansion

Unit -IV

Research Process Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data

Unit -V

Structure of a Research Document Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results, Conclusion, Documenting Sources (IEEE style)

Suggested Books:

1. Bailey, S. (2014). Academic writing: A handbook for international students. Routledge.

2. Gillett, A., Hammond, A., & Martala, M. (2009). Inside track: Successful academic writing. Essex: Pearson Education Limited.

3. Griffin, G. (2006). Research methods for English studies. Edinburgh: Edinburgh University Press.

4. Silyn-Roberts, Heather. (2013). Writing for Science and Engineering: Papers, Presentations and Reports (2nd ed.). Elsevier.

5. Lipson, Charles (2011). Cite right: A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more (2nd ed.). Chicago [u.a.]: University of Chicago Press.

6. Mark Cholij 2007TowardsAcademicEnglish; Developing Effective Writing Skills Cambridge University Press India Ltd., New Delhi India

Course Code	Course Title						Core/Elective
	Lab 6: Networks Security Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1

Course Outcomes

After Completing This Course, the student will be able to:

- Understandtheapplicationsofdifferentdatastructurestosolvecomplexproblems
- Applyvariousalgorithmsfordiverseproblemsandmeasuretheperformanceofvariousalgorithms.

Course Code	Course Title						Core/Elective
	Technical seminar						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**4**	**50**	-	**2**

Course Outcomes

Attend This Course, students will be able to**:**

- Develop the habit of referring the journals for literature review.
- Understand The Gist of The Research Paper.
- Identify The Potential for Further Scope.
- Present The Work in An Efficient Manner.
- Write The Documentation Standard Format.

Guidelines:

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally presentation of their work for assessment.
- Each student will be allotted faculty supervisor for mentoring.
- **T**echnical seminars should present students with accessible challenges. Demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Technical seminars shall have inter-disciplinary/industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical Modeling
- Alltheinvestigationsshouldbeclearlystatedanddocumentedwiththereasons/explanations.
- The **Technical seminar shall** contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables and detailed discussion results, conclusion and reference

Departmental Committee
Supervisor And a Minimum Of Two Faculty Members

Guidelines for awarding marks in CIE(Continuous Internal Evaluation): Max.Marks:50		
Evaluated By	**Max.Marks**	**EvaluationCriteria/Parameter**
Supervisor	20	ProgressandReview
	05	Report
Departmental Committee	05	RelevanceoftheTopic
	05	PPTPreparation
	05	Presentation
	05	QuestionandAnswers
	05	ReportPreparation

Course Code	Course Title						Core/Elective
	Internship (Inhouse or Outside the college)						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**4**	**50**	**-**	**2**

Course Outcomes

Attend This Course, students will be able to**:**

- Formulate a specific problem and give solution
- Develop Model/model either theoretical/practical/numerical form
- Solve, interpret/correlate the results and discussions
- Conclude The Results Obtained
- Write The Documentation Standard Format

Guidelines:

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks active research, and finally presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- **Internship** should present students with accessible challenges. Demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- **Internship** shall have inter-disciplinary/industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical Modeling
- Alltheinvestigationsshouldbeclearlystatedanddocumentedwiththereasons/explanations.
- The **Internship** shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion results, conclusion and reference

Departmental Committee: Supervisor and A Minimum Of Two Faculty Members

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max.Marks:50		
Evaluated By	**Max.Marks**	**EvaluationCriteria/Parameter**
Supervisor	20	ProgressandReview
	05	Report
Departmental Committee	05	RelevanceoftheTopic
	05	PPTPreparation
	05	Presentation
	05	QuestionandAnswers
	05	ReportPreparation

Course Code	Course Title						Core/Elective
PC2156CS	**Major Project Phase–I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**20**	**100**	**-**	**10**

Course Outcomes

Attend This Course, students will be able to:

- Exposed To Self-learning various topics.
- Learn to survey the literature such as books, journals and contact resource persons for the selected topic research.
- Learn To Write Technical Reports.
- Develop Oral and Written Communication Skills To Present.
- Defend their work in front of technically qualified audience

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The Preliminary Results (if available)of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Chairperson-BoS, Osmania University Head, Supervisor Project coordinator from the respective Department of the Institute.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation):Max.Marks:100		
Evaluation by	**Max.Marks**	**Evaluation Criteria/Parameter**
Supervisor	30	ProjectStatus/Review(s)
	20	Report
Departmental Committee(Chairperson BoS, Head, CSE MVSREC Supervisor & Project coordinator from the respective department of the institution)	10	RelevanceoftheTopic
	10	PPTPreparation
	10	Presentation
	10	QuestionandAnswers
	10	ReportPreparation

Note: TheSupervisorhastoassesstheprogressofthestudentregularly.

Course Code	Course Title						Core/Elective
PC2157CS	**Major Project Phase – II(Dissertation)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**32**	**-**	**200**	**16**

Course Outcomes

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

- Use different experimental techniques and will be able to use different software/computational/analytical tools.
- Design and develop an experimental setup/equipment/testrig.
- Conducttestsonexistingsetups/equipmentsanddrawlogicalconclusionsfromtheresult safteranalysingthem.
- Either work in a research environment or in an industrial environment.
- Conversant with technical report writing and will be able to present and convince heir topic of study to the engineering community.

Guidelines:

- It is a continuation of Major Project Phase– I started in semester-III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS & Head Osmania University and Supervisor from the Institute.
- The candidate has to be in regular contact with his / her Supervisor/Co-Supervisor

Guidelines for awarding marks in SEE (Semester End Examination): Max.Marks:200		
Evaluation by	**Max.Marks**	**EvaluationCriteria/Parameter**
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	30	Quality of the work which may lead to publications
	10	Analytical/Programming/Experimental Skills Preparation
	10	Report preparation in a standard format
External Examiner and Chairperson, BoS & CSE Head, MVSREC (All together)	20	Power Point Presentation
	60	Quality of thesis and evaluation
	30	Innovations, application to society and Scope for future study
	20	Viva-Voce