Syllabus for Autonomous Batch 2020-2024 B. TECH

Computer Science and Engineering

INSTITUTE OF ENGINEERING & MANAGEMENT

Semester III (Second year) Curriculum								
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**				**Credits**
				Lecture	**Tutorial**	**Practical**	**Sessional**	
Theory Papers								
1	Engineering Science Course	ESC301	Analog Electronic Circuits	3	0	0	0	3
2	Professional Core Courses	PCCCS301	Data structure & Algorithms	3	0	0	0	3
3	Professional Core Courses	ESC302	Digital Electronics	3	0	0	0	3
4	Professional Core Courses	PCCCS302	IT Workshop	1	0	0	0	1
5	Basic Science course	BSC301	Mathematics & Statistics III	3	0	0	0	3
6	Humanities & Social Sciences including Management courses	HSMC301	Humanities-I (Technical Report Writing)	3	0	0	0	3
7	Humanities and social sciences including Management	HSMC302	Essential Studies for Professionals - III	2	0	0	0	2
	Total			**18**	**0**	**0**	**0**	**18**
Practical Papers								
1	Engineering Science Course	ESC391	Analog Electronic Circuits Lab	0	0	4	0	2
2	Professional Core Courses	PCCCS391	Data structure & Algorithms Lab	0	0	4	0	2
3	Professional Core Courses	ESC392	Digital Electronics Lab	0	0	4	0	2
4	Professional Core Courses	PCCCS392	IT Workshop (Sci Lab/Python/R) Lab	0	0	4	0	2

	Total			**0**	**0**	**16**	**0**	**8**
Sessional Papers								
1	Humanities and social sciences including Management	HSMC382	Skill Development for Professionals - III	0	0	0	2	1
2	Innovative Project	PROJCS301	Innovative Project - I	0	0	0	0	1
3	Mandatory Additional Requirements	MAR381	Mandatory Additional Requirements	0	0	0	0	0

	(MAR)		(MAR)-III					
4	MOOCs (Mandatory for Honours)	MOOCs321	Massive Open Online Course 3.1 (Mandatory for B.Tech (Honours))	0	0	0	1	.5
5		MOOCs322	Massive Open Online Course 3.2 (Mandatory for B.Tech (Honours))	0	0	0	1	.5
	Total			**0**	**0**	**0**	**4**	**3**
	Total			**18**	**0**	**16**	**4**	**29**
Semester IV (Second year) Curriculum								
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**				**Credits**
				Lecture	**Tutorial**	**Practical**	**Sessional**	
Theory Papers								
1	Professional Core Courses	PCCCS401	Discrete Mathematics	3	1	0	0	4
2	Engineering Science Course	PCCCS 402	Computer Organization & Architecture	3	0	0	0	3
3	Professional Core Courses	PCCCS403	Operating Systems	3	0	0	0	3
4	Professional Core Courses	PCCCS404	Design & Analysis of Algorithms	3	0	0	0	3
5	Professional Core Courses	PCCCS405	Artificial Intelligence & Machine Learning	2	0	0	0	2
6	Humanities &Social Sciences including Management courses	HSMC401	Management 1 (Organizational Behaviour)	3	0	0	0	3
7	Mandatory Courses	MC401	Environmental Sciences	2	0	0	0	0
8	Humanities and social sciences including	HSMC402	Essential Studies for Professionals - IV	2	0	0	0	2

	Managem ent							
	Tot al			**21**	**1**	**0**	**0**	**20**
Practical Papers								
1	Engineerin g Science Course	PCCCS492	Computer Organizatio n & Architecture Lab	0	0	4	0	2
2	Professio nal Core Courses	PCCCS493	Operating Systems Lab	0	0	4	0	2
3	Professio nal Core Courses	PCCCS494	Design & Analysis of Algorithms Lab	0	0	4	0	2

3	Professional Core Courses	PCCCS495	Artificial Intelligence & Machine Learning Lab	0	0	2	0	1
	Total			**0**	**0**	**14**	**0**	**7**
Sessional Papers								
1	Humanities and social sciences including Management	HSMC482	Skill Development for Professionals - IV	0	0	0	2	1
2	Innovative Project	PROJCS401	Innovative Project – II (Problem Solving Approaches using Design Patterns)	0	0	0	0	1
3	Mandatory Additional Requirements (MAR)	MAR481	Mandatory Additional Requirements (MAR)-IV	0	0	0	0	0
4	MOOCs (Mandatory for Honours)	MOOCs421	Massive Open Online Course 4.1 (Mandatory for B.Tech (Honours))	0	0	0	1	0.5
5		MOOCs 422	Massive Open Online Course 4.2 (Mandatory for B.Tech (Honours))	0	0	0	1	0.5
	Total			**0**	**0**	**0**	**4**	**3**
	Total			**21**	**1**	**14**	**4**	**30**
Semester V (Third year) Curriculum								
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**				**Credits**
				Lecture	**Tutorial**	**Practical**	**Sessional**	
Theory Papers								
1	Engineering Science Course	ESC501	Signals & Systems	3	0	0	0	3
2	Professional Core Courses	PCCCS501	Database Management Systems	3	0	0	0	3
3	Professional Core Courses	PCCCS502	Formal Language & Automata Theory	3	0	0	0	3

4	Professional Core Courses	PCCCS503	Object Oriented Programming	2	0	0	0	2
5	Professional Core Courses	PCCCS504	Software Engineering	2	0	0	0	2
6	Humanities & Social Sciences including Management courses	HSMC501	Humanities II (Principles of Management)	3	0	0	0	3

7	Professional Elective courses	PECCS501	Professional Elective-I	3	0	0	0	3
8	Mandatory Courses	MC501	Constitution of India/ Essence of Indian Knowledge Tradition	2	0	0	0	0
9	Humanities and social sciences including Management	HSMC502	Essential Studies for Professionals - V	2	0	0	0	2
	Total			**23**	**0**	**0**	**0**	**21**
Practical Papers								
1	Professional Core Courses	PCCCS591	Database Management Systems Lab	0	0	4	0	2
2	Professional Core Courses	PCCCS593	Object Oriented Programming Lab	0	0	4	0	2
3	Professional Core Courses	PCCCS594	Software Engineering Lab	0	0	2	0	1
	Total			**0**	**0**	**10**	**0**	**5**
Sessional Papers								
1	Humanities and social sciences including Management	HSMC582	Skill Development for Professionals - V	0	0	0	2	1
2	Innovative Project	PROJCS501	Innovative Project - III	0	0	0	0	1
3	Mandatory Additional Requirements (MAR)	MAR581	Mandatory Additional Requirements (MAR)-V	0	0	0	0	0
4	MOOCs	MOOCs 521	Massive Open Online Course 5.1 (Mandatory for B.Tech (Honours))	0	0	0	1	1

5	(Mandatory for Honours)	MOOCs 522	Massive Open Online Course 5.2 (Mandatory for B.Tech (Honours))	0	0	0	1	1
Total				**0**	**0**	**0**	**4**	**4**
Total				**23**	**0**	**10**	**4**	**30**
Semester VI (Third year) Curriculum								
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**				**Credits**
				Lecture	**Tutorial**	**Practical**	**Sessional**	
Theory Papers								

1	Professional Core Courses	PCCCS601	Compiler Design	3	0	0	0	3
2	Professional Core Courses	PCCCS602	Computer Networks	3	0	0	0	3
3	Professional Core Courses	PCCCS603	Cloud Computing & IoT	2	0	0	0	2
4	Professional Elective courses	PECCS601	Professional Elective-II	3	0	0	0	3
5	Professional Elective courses	PECCS602	Professional Elective-III	3	0	0	0	3
6	Open Elective courses	OECCS601	Open Elective-I	3	0	0	0	3
7	Humanities and social sciences including Management	HSMC602	Essential Studies for Professionals - VI	2	0	0	0	2
	Total			**19**	**0**	**0**	**0**	**19**
Practical Papers								
1	Professional Core Courses	PCCCS691	Compiler Design Lab	0	0	4	0	2
2	Professional Core Courses	PCCCS692	Computer Networks Lab	0	0	4	0	2
3	Professional Core Courses	PCCCS693	Cloud Computing & IoT Lab	0	0	2	0	1
4	Innovative Project	PROJCS601	Project-1	0	0	6	0	3
	Total			**0**	**0**	**16**	**0**	**8**
Sessional Papers								
1	Humanities and social sciences including	HSMC682	Skill Development for Professionals - VI	0	0	0	2	1

	Management							
2	Mandatory Additional Requirements (MAR)	MAR681	Mandatory Additional Requirements (MAR)-VI	0	0	0	0	0
3	MOOCs (Mandatory for Honours)	MOOCs 621	Massive Open Online Course 6.1 (Mandatory for B.Tech (Honours))	0	0	0	1	.5

4		MOOCs 622	Massive Open Online Course 6.2 (Mandatory for B.Tech (Honours))	0	0	0	1	1
	Total			**0**	**0**	**0**	**4**	**2.5**
	Total			**19**	**0**	**16**	**4**	**29.5**
Semester VII (Fourth year] Curriculum								
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**				**Credits**
				Lecture	**Tutorial**	**Practical**	**Sessional**	
Theory Papers								
1	Professional Elective courses	PCCCS701	Network Security & Cryptography	2	0	0	0	2
2	Professional Elective courses	PECCS701	Professional Elective-IV	3	0	0	0	3
3	Professional Elective courses	PECCS702	Professional Elective-V	3	0	0	0	3
4	Open Elective courses	OECCS701	Open Elective-II	3	0	0	0	3
5	Humanities and social sciences including Management	HSMC702	Essential Studies for Professionals - VII	2	0	0	0	2
	Total			**13**	**0**	**0**	**0**	**13**
Practical Papers								
1	Innovative Project	PROJCS701	Project-II	**0**	**0**	**12**	**0**	**6**
Sessional Papers								
1	Humanities and social sciences including Management	HSMC782	Skill Development for Professionals - VII	0	0	0	2	1

2	Mandatory Additional Requirements (MAR)	MAR781	Mandatory Additional Requirements (MAR) -VII	0	0	0	0	0
3	MOOCs (Mandatory for Honours)	MOOCs 721	Massive Open Online Course 7.1 (Mandatory for B.Tech (Honours))	0	0	0	3	3
4		MOOCs 722	Massive Open Online Course 7.2 (Mandatory for B.Tech (Honours))	0	0	0	2	2
	Total			**0**	**0**	**0**	**7**	**6**

				Lecture	Tutorial	Practical	Sessional	Credits
	Total			**13**	**0**	**12**	**7**	**25**

Semester VIII (Fourth year] Curriculum

Sl. No.	Type of course	Code	Course Title	Hours per week				Credits
				Lecture	Tutorial	Practical	Sessional	
Theory Papers								
1	Professional Elective courses	PECCS801	Professional Elective-VI	3	0	0	0	3
2	Open Elective courses	OECCS801	Open Elective-III	3	0	0	0	3
3	Open Elective courses	OECCS802	Open Elective-IV	3	0	0	0	3
4	Humanities and social sciences including Management	HSMC802	Essential Studies for Professionals - VIII	2	0	0	0	2
	Total			**11**	**0**	**0**	**0**	**11**
Practical Papers								
1	Innovative Project	PROJCS801	Project-III	0	0	12	0	6
	Total			**0**	**0**	**12**	**0**	**6**
Autonomous Papers								
1	Humanities and social sciences including Management	HSMC882	Skill Development for Professionals - VIII	0	0	0	2	1
2	Mandatory Additional Requirements (MAR)	MAR881	Mandatory Additional Requirements (MAR)-VIII	0	0	0	0	0

3	MOOCs (Mandatory for Honours)	MOOCs 821	Massive Open Online Course 8.1 (Mandatory for B.Tech (Honours))	0	0	0	3	3
4		MOOCs 822	Massive Open Online Course 8.2 (Mandatory for	0	0	0	2	2

			B.Tech (Honours))					
5	Grand viva	PCCCS881	Grand Viva-voce	0	0	0	0	2
	Total			**11**	**0**	**0**	**7**	**8**
	Total			**11**	**0**	**12**	**7**	**25**
	Total Credit Points							**168.5**

PROFESSIONAL ELECTIVE COURSES

Computer System Design (A)	**Data Science (B)**	**Computer Vision (C)**	**Cryptography and BlockChain (D)**
Advanced Algorithms	Introduction to Data Science	Deep Learning	Distributed Systems
VLSI	Principles of Artificial Intelligence and Deep Learning	Computer Graphics	Cyber Security
Graph Theory	Soft Computing	Web and Internet Technology	Digital Forensics
Embedded Systems	Data Mining	Image Processing	Mobile Computing
Real Time OS	Natural Language Processing	Principles of Computer Vision	Introduction to BlockChain
Parallel Computing	Pattern Recognition	Augmented Reality and Virtual Reality	Data Encryption and Compression

OPEN ELECTIVE COURSES

Quantum Computation and Quantum Information
History of Science & Engineering
Enterprise Systems
Soft Skills and Interpersonal Communication
Social Network Analysis
Introduction to Philosophical Thoughts
Cyber Law, IPR and Ethics
Economic Policies in India

3rd Semester

Course Name: Analog Electronic
Circuits Course Code: ESC301
Semester: 3
Contact Hours: L-T-P: 3-0-
0 Credits: 3
Prerequisites: Physics, Basic Electronics Engineering

Module 1 [3L]

Multivariate Diode circuits

PN junction diode, IV characteristics of a diode; review of halfwave and fullwave rectifiers, Zener diodes, clamping and clipping circuits

Module 2

[15L] BJT

circuits

Structure and IV characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

MOSFET circuits

MOSFET circuits MOSFET structure and IV characteristics. MOSFET as a switch. MOSFET as an amplifier: small signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits-gain, input and output impedances, transconductance, high frequency equivalent circuit.

Module 3 [12L]

Types of Amplifiers

Differential, multistage and operational amplifiers: Differential amplifier; power amplifier; direct coupled multistage amplifier;

Operation Amplifiers

Internal structure of an operational amplifier, ideal opamp, nonidealities in an opamp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Linear applications of opamp; Idealized analysis of opamp circuits. Inverting and noninverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an opamp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module 4 [5L]

Non-Linear Operational Amplifiers

Nonlinear applications of opamp Hysteretic Comparator, Zero Crossing Detector, Square wave and triangular wave generators. Precision rectifier, peak detector. Monoshot.

Text Books and/or Reference Material

1. Boylestad, Robert L., and Louis Nashelsky. "Electronic Devices and Circuit Theory 11th ed." (2018).

2. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.

3. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.

4. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

5. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

6. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

7. Analog Electronics, L.K. Maheshwari, Laxmi Publications

8. Analog Electronics, A.K. Maini, Khanna Publishing House

9. Analog Electronics, I.G. Nagrath, PHI

Course Outcome:

CO1: To study and understand the principles of diodes, transistors and their variants.
CO2: To study the various general applications of transistors and their variants.
CO3: To study and understand the principles of amplifiers and operational amplifiers.
CO4: To study the various general applications of operational amplifiers.

Course Name: Data Structure & Algorithms
Course Code: PCCCS301
Semester: 3
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisite: Introduction to Programming (Python)

Module 1 [8L]

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module 2 [9L]

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

Module 3 [10L]

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Double linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4 [9L]

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Text Books and/or Reference Material

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by by Mark Allen Weiss.

3. Mark Allen Weiss, Addison-Wesley Publishing Company "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

4. Fundamentals of Data Structures, Sartaj Sahni, UniversityPress

5. Data Structures, RS Salaria, Khanna PublishingHouse

6. Data Structures through C, Yashwant Kanetkar, BPBPublications

7. Expert Data Structures with C++, RB Patel, KhannaPublications

Course Outcomes (CO):

CO1: Students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C, how their drawbacks can be overcome and what the applications are and where they can be used.

CO2: Students should be able to learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the run-time) or for better memory utilization, based on the priority of the implementation.

CO3: Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS 503 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course.

CO4: The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course.

Course Name: Digital Electronics Course Code: ESC302
Semester: 3
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisite: Basic Electronics

Module 1 [10L]

Binary Number System & Boolean Algebra; BCD, ASCII, EBCDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods; Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic expressions by KMAP.

Module 2 [6L]

Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator.

Module 3 [11L]

Sequential Circuits - Basic Flip-flop & Latch; Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops; Registers (SISO, SIPO, PIPO, PISO); Ring counter, Johnson counter; Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded); Design of Mod N Counter.

Module 4 [3L]

A/D and D/A conversion techniques – Basic concepts; Logic families- TTL, ECL, MOS and CMOS - basic concepts.

Text Books and/or Reference Material

1. Digital Logic Design by Morris Mano - PHI
2. Digital Electronics by S. Salivahanan,S. Arivazhagan-OXFORD
3. Digital Electronics by P.Raja - Scitech Publications
4. Digital Fundamentals by Floyed & Jain -Pearson.
5. Microelectronics Engineering by Sedra & Smith-Oxford.
6. Principles of Electronic Devices & circuits by B L Thereja & Sedha, S Chand

Digital Electronics, Kharate –Oxford

Course Outcomes (CO):

CO1: Students would be able to convert from one number system to another, work out and design problems related to Boolean algebra, minimization etc.

CO2: Have the ability to identify basic requirements for a design application and propose a cost-effective solution.

CO3: Have the ability to understand, analyse and design various combinational and sequential circuits.

CO4: Have the ability to understand, analyse and design various A/D D/A conversion techniques

Course Name: Mathematics & Statistics
III Course Code: BSC301
Semester: 3
Contact Hours: L-T-P: 3-0-
0 Credits: 3
Prerequisite: Linear Algebra, Ordinary Differential Equation, Theory of Probability

Module 1[16L]

Complex analysis

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Module 2 [12L]

Random Variable & Probability Distributions

Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3 [8L]

Basic Statistics
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Module 4 [4L]

Bivariate Distributions

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Text Books and/or Reference Material

1.G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.

2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill,2004.

4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).

7. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

8. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

9. Lipschutz S., and Lipson M.L.: Probability (Schaum's Outline Series), TMH.

10. John E. Freund, Ronald E. Walpole, Mathematical Statistics, Prentice Hall.

Course Outcomes (CO):

CO1: Identify different tools of differentiation and integration of functions of a complex variable that are used with various other techniques for solving engineering problems.

CO2: Illustrate the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in the physical and engineering environment.

CO3: Categorize statistical tools for analyzing data samples and apply linear regression models in practice, and identify situations where linear regression is appropriate.

CO4: Interpret the ideas of bi-variate distributions with their properties and the applications in physical and engineering environments.

Course Name: IT Workshop
Course Code: PCCCS302
Semester: 3
Contact Hours: L-T-P: 1-0-0
Credits: 1
Prerequisite: Linear Algebra

Module 1 [3L]

Approximation in numerical computation: Truncation and rounding errors, Propagation of errors; Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method.

Module 2 [5L]

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation; Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Numerical Differentiation.

Module 3 [4L]

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator corrector methods.

Module 4 [3L]

Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.

Text Books and/or Reference Material

1. Dutta & Jana: Introductory Numerical Analysis.

2. J.B.Scarborough: Numerical Mathematical Analysis.

3. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).

COURSE OUTCOMES

1. **Students would be able to assess the approximation techniques to formulate and apply appropriate strategies to solve real world problems.**
2. **Be familiar with systems of interpolations and integrations.**
3. **Be familiar with numerical solutions of ordinary differential equations.**
4. **Be familiar with systems of linear equations.**

Course Name: Humanities – 1 (Technical Report Writing) Course Code: HSMC301

Semester: 3

Contact Hours: L-T-P: 3 -0 -0

Credits: 3

Module 1 [10L]

A. Technical Report Writing-

1. Report Types (Organizational / Commercial / Business / Project)
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)

B. Language Laboratory Practice-

1. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory Practice Sessions

Module 2 [8L]

Conversation Practice Sessions: (To be done as real life interactions)

a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's

to get their Listening Skill & Speaking Skill honed
b) Introducing Role Play & honing over all Communicative Competence

Module 3 [10L]

Group Discussion Sessions:
a) Teaching Strategies of Group Discussion
b) Introducing Different Models & Topics of Group Discussion
c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial
measure Interview
Sessions;
a) Training students to face Job Interviews confidently and successfully
b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication.

Module 4 [8L]

Presentation
a) Teaching Presentation as a skill
b) Strategies and Standard Practices of Individual /Group Presentation
c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual
Aids Competitive Examination:
a) Making the students aware of Provincial /National/International
Competitive Examinations
b) Strategies/Tactics for success in Competitive Examinations) SWOT Analysis and its Application in fixing Target

Text Books and/or Reference Material

1. Adrian Duff et. al. (ed.): Cambridge Skills for Fluency –
A) Speaking (Levels 1-4 Audio Cassettes/Handbooks)
B) Listening (Levels 1-4 Audio Cassettes/Handbooks) Cambridge University Press 19982.
2. Hancock: English Pronunciation in Use 4 Audio Cassettes/CD'S OUP 2004

Course Outcome:

CO1: Students should be proficient in Technical report writing

CO2: Students should be able to develop good listening and speaking skills

CO3: Students should have knowledge about Group discussion and different interview techniques

CO4: Students should be able to give professional presentations

Course Name: Analog Electronic Circuits
Lab Course Code: ESC391
Semester: 3
Contact Hours: L-T-P: 0-0-
4 Credits: 2
Prerequisites: Physics, Basic Electronics

1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative). **(3L)**

2. Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency: (a). Full Wave Rectifier (b). Bridge Rectifier **(2L)**

3. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain-bandwidth product from its frequency response. **(3L)**

4. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency. **(3L)**

5. Design standard inverting & non-inverting operational amplifier and study its transfer characteristics, along with modifications required to design voltage follower and phase-shift unity gain amplifier. **(3L)**

6. Design operational amplifier for summing of equal-weighted inputs signals, summing of variable-weighted inputs signals, and averaging of inputs signals and study its transfer characteristics, along with modification for inverting and non-inverting configurations. **(2L)**

7. Design operational amplifier for difference of equal-weighted inputs signals, and difference of variable-weighted inputs signals and study its transfer characteristics. **(3L)**

8. Design operational amplifier for high-pass, low-pass and band-pass filters. **(3L)**

9. Design of comparators, Schmitt trigger using op-amp and square and sawtooth wave genetaors using op-amps. **(2L)**

<u>Text Books and/or Reference Material</u>

1. Boylestad, Robert L., and Louis Nashelsky. "Electronic Devices and Circuit Theory 11th ed." (2018).

2. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.

3. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”,

John Wiley & Sons, 2001.

4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.

5. Analog Electronics, L.K. Maheshwari, Laxmi Publications

Course Outcome:

CO1: To study, understand and apply the principles of diodes, transistors and their variants.
CO2: To study, understand and apply the various general applications of transistors and their variants.
CO3: To study, understand and apply the principles of amplifiers and operational amplifiers.
CO4: To study, understand and apply the various general applications of operational amplifiers.

Course Name: Data Structure & Algorithms Lab
Course Code: PCCCS391
Semester: 3
Contact Hours: L-T-P: 0-0-
4 Credits: 2
Prerequisite: Introduction to Programming

Linear Data Structure [12L]

1. Implementation of array operations

2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements

3. Merging Problem: Evaluation of expressions operations on Multiple stacks & queues.

4. Implementation of linked lists: inserting, deleting, and inverting a linked list.

5. Implementation of stacks & queues using linked lists.

6. Polynomial addition, Polynomial multiplication.

Non-Linear Data Structure [12L]

7. Recursive and Non-recursive traversal of Trees

8. Threaded binary tree traversal. AVL tree implementation

9. Application of Trees. Application of sorting and searching algorithms

10. Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Text Books and/or Reference Material

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by by Mark Allen Weiss.

3. Mark Allen Weiss, Addison-Wesley Publishing Company "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

4. Fundamentals of Data Structures, Sartaj Sahni, UniversityPress

5. Data Structures, RS Salaria, Khanna PublishingHouse

6. Data Structures through C, Yashwant Kanetkar, BPBPublications

7. Expert Data Structures with C++, RB Patel, KhannaPublications

Course Outcomes (CO):

CO1: Students are expected to be capable of understanding the data structures, their advantages and drawbacks, how to implement them in C, how their drawbacks can be overcome and what the applications are and where they can be used.

CO2: Students should be able to learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective so as to make use of the most appropriate data structure/ method/algorithm in a program to enhance the efficiency (i.e. reduce the run-time) or for better memory utilization, based on the priority of the implementation.

CO3: Detailed time analysis of the graph algorithms and sorting methods are expected to be covered in CS 503 but it is expected that the students will be able to understand at least the efficiency aspects of the graph and sorting algorithms covered in this course.

CO4: The students should be able to convert an inefficient program into an efficient one using the knowledge gathered from this course.

Course Name: IT Workshop (Sci Lab/Python/R) Lab Course
Code: PCCCS392
Semester: 3
Contact Hours: L-T-P: 0-0-
4 Credits: 2
Prerequisite: Introduction to Programming

Module 1 [8L]

- Introduction to Python and Computer Programming
  - Data Types, Variables, Basic Input-Output Operations, Basic Operators, Python literals, Boolean Values, Conditional Execution,
- Loops,
- Lists and List Processing,
  - Lists - collections of data
- Logical and Bitwise Operations,
  - Making decisions in Python, Logic and bit operations in Python,
- Functions,
  - Returning a result from a function, Scopes in Python, Modules
- Tuples,
- Dictionaries,
- Packages,
- String and List Methods,
- Exceptions,
- Working with Files,
  - Processing files, working with real files.
- The Object-Oriented Approach
  - Classes, Methods, Objects,

Module 2 [4L]

.ML packages,
.numpy,
.sklearn,
.pandas,
.matplotlib,
.supervised and unsupervised learning.

Module 3 [3L]

.Overview of R,
.R data types and objects,
.reading and writing data,
.Control structures,
.functions,
.Loop functions

.Machine Learning using R

Module 4 [9L]

Numerical Methods using Scilab –

Overview of Scilab

Installation of the software Scilab. Basic syntax, Mathematical Operators, Predefined constants, Built in functions. Complex numbers, Polynomials, Vectors, Matrix. Handling these data structures using built in functions. Programming; Functions, Loops, Conditional statements, Handling .sci files, Graphics handling, 2D, 3D, Generating .jpg files.

Solving of Numerical Methods using Scilab –

Finding of Determinant using Sarrus Method and Upper triangular matrix Method.

Solve System of Linear equations using Gauss Elimination Method and Gauss Seidal Method.

Implement interpolation for equal and unequal intervals both.

Implement Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule.

Solve differential equations using Euler's Method, Modified Euler's Method, Runge-kutta Method and Predictor Corrector Method.

Text Books and/or Reference Material

1. Learning Python 5ed: Powerful Object-Oriented Programming by Mark Lutz, O'Reilly Publication
2. Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition by Andreas C. Müller, Sarah Guido, O'Reilly Publication
3. Hands-On Programming with R: Write Your Own Functions and Simulations 1st Edition, by Garrett Grolemund, O'Reilly Publication
4. Introduction to Machine Learning with R: Rigorous Mathematical Analysis by Scott Burger, O'Reilly Publication

Course Outcomes (CO):

CO1:Students will be proficient in Python programming including loop, data structure in python, functions, exceptions, working with files and implementation of OOPS.

CO2:Students will gain in depth knowledge about different Machine Learning packages like numpy, sklearn, pandas etc

CO3:Students will get a basic understanding of R language.

CO4:Using Scilab students will be able to implement different numerical method formulas.

Course Name: Digital Electronics
Lab Course Code: ESC392
Semester: 3
Contact Hours: L-T-P: 0-0-
4 Credits: 2
Prerequisite: Basic Electronics Lab

1. Design a Full Adder using basic gates and verify its output / Design a Full Subtractor circuit using basic gates and verify its output. **[4L]**

2. Construction of simple Decoder & Multiplexer circuits using logic gates. **[4L]**

3. Realization of RS / JK / D flip flops using logic gates. **[4L]**

4. Design of Shift Register using J-K / D Flip Flop. **[3L]**

5. Realization of Synchronous Up/Down counter. **[3L]**

6. Design of MOD - N Counter. **[3L]**

7. Study of DAC. **[3L]**

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Text Books and/or Reference Material

1. Digital Logic Design by Morris Mano - PHI
2. Digital Electronics by S. Salivahanan,S. Arivazhagan-OXFORD

Course Outcomes (CO):

CO1: Students would be able to convert from one number system to another, work out and design problems related to Boolean algebra, minimization etc.

CO2: Have the ability to identify basic requirements for a design application and propose a cost-effective solution.

CO3: Have the ability to understand, analyse and design various combinational and sequential circuits.

CO4: Have the ability to understand, analyse and design various A/D D/A conversion techniques

4^{th} Semester

Course Name: Discrete Mathematics Course Code: PCCCS401
Semester: 4
Contact Hours: L-T-P: 3-1-
0 Credits: 4

Prerequisite: Linear algebra, Calculus

<u>Module 1 [9L]</u>

Propositional Logic

Logical Connectives, Conjunction, Disjunction, Negation and their truth table. Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Biconditional statements with truth table, Logical Equivalence, Tautology, Normal forms - CNF, DNF; Predicates and Logical Quantifications of propositions and related examples.

<u>Module 2 [9L]</u>

Theory of Numbers

Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic;

Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruences, Residue classes of integer modulo ( ) n n Z and its examples;

Order, Relation and Lattices:

POSET, Hasse Diagram, Minimal, Maximal, Greatest and Least elements in a POSET, Lattices and its properties, Principle of Duality, Distributive and Complemented Lattices.

<u>Module 3 [12L]</u>

Counting Techniques

Permutations, Combinations, Binomial coefficients, Pigeon- hole Principle, Principles of inclusion and exclusions; Generating functions, Recurrence Relations and their solutions using generating function, Recurrence relation of Fibonacci numbers and its solution, Divide- and-Conquer algorithm and its recurrence relation and its simple application in computer.

<u>Module 4</u>

<u>[12L]</u> Graph

Coloring

Chromatic Numbers and its bounds, Independence and Clique Numbers, Perfect Graphs- Definition and examples, Chromatic polynomial and its determination, Applications of Graph Coloring.

Matchings

Definitions and Examples of Perfect Matching, Maximal and Maximum Matching, Hall's Marriage Theorem (Statement only) and related problems.

<u>Text Books and/or Reference Material</u>

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill.

2. Russell Merris, Combinatorics, WILEY-INTERSCIENCE SERIES IN DISCRETE MATHEMATICS AND OPTIMIZATION

3. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI

4. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning.

5. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH

Course Outcomes (CO):

CO1: Ability to apply mathematical logic to solve problems

CO2: Understand sets, relations, functions and discrete structures

CO3: Able to use logical notations to define and reason about fundamental mathematical concepts such as sets relations and functions

CO4: Able to formulate problems and solve recurrence relations and able to model and solve real world problems using graphs and trees

Course Name: Computer Organization & Architecture
Course Code: PCCCS402
Semester: 4
Contact Hours: L-T-P: 3-0-0 Credits: 3

Prerequisite: Digital Electronics

Module 1 [7L]

Introduction to computer organisation & architecture; Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes; Quantitative techniques in computer design – Part1; Introduction to RISC architectures. RISC vs CISC architectures

Module 2 [8L]

Commonly used number systems. Fixed and floating-point representation of numbers; Concept of Overflow and Underflow. Design of adders - ripple carry and carry look ahead principles. Fixed point multiplication - Unsigned and Signed - Booth's algorithm. Fixed point division - Restoring and non-restoring algorithms. Floating point - IEEE 754 standard. Design of ALU. Design of control unit - hardwired and microprogrammed control. Introduction to Von-Neumann & Harvard Architecture

Module 3 [8L]

Memory organization, static and dynamic memory, memory hierarchy, associative memory. Hierarchical memory technology: Inclusion, Coherence and locality properties Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies. Memory unit design with special emphasis on implementation of CPU-memory interfacing. Data path design for read/write access. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA

Module 4 [15L]

Quantitative techniques in computer design – Part2; Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Pipeline optimization techniques, Compiler techniques for improving performance.

Multiprocessor architecture: taxonomy of parallel architectures - Introduction to Flynn's Classification; Centralized shared - memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared memory architecture. Non von-Neumann architectures - Data flow computers.

Text Books and/or Reference Material

1. Computer Organization and Architecture: Designing for Performance, William

Stallings, Prentice-Hall India

2. Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Tata

McGraw Hill

3. Computer Architecture A Quantitative Approach, John L Hennessy and David

Patterson, Morgan Kaufman

4. Structured Computer Organization, Andrew S. Tanenbaum, Prentice-Hall India

5. Computer Architecture & Parallel Processing. Kai Hwang & Briggs, Tata McGraw Hill

6. Computer System Architecture, M. M. Mano, PHI.

7. Computer Organization & Architecture, P N Basu, Vikas Publication

COURSE OUTCOMES

CO1: Students would be able to apply instruction set architecture for designing a processor.

CO2: Students would be able to design arithmetic and logic units as well as control units of a processor.

CO3: Students would be able to understand different types of memory, memory management, and the connection among the memory, CPU and I/O devices.

CO4: Students would be able to understand parallel processors.

Course Name: Operating
Systems Course Code: PCCCS403
Semester: 4
Contact Hours: L-T-P: 3-0-0
Credits: 3

Module 1 [4L]

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2 [16L]

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

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

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 3 [8L]

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 4 [8L]

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software,

Secondary-Storage Structure: Disk structure, Disk scheduling algorithms **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Text Books and/or Reference Material

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

3. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing

4. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, AddisonWesley

5. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

6. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes:

CO1: Learn and understand the design issues associated with Operating Systems..

CO2: To be familiar with multithreading and multiprogramming.

CO3: Learn and use the disk management and disk scheduling algorithms for effective utilization of

external memory.

CO4: Learn the various CPU scheduling algorithms and deadlock avoidance algorithms for efficient use of system resources.

Course Name: Design & Analysis of Algorithms

Course Code: PCCCS404
Semester: 4
Contact Hours: L-T-P: 3-0-
0 Credits: 3

Prerequisite: Data Structure and Algorithms

Module 1[6L]

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Module 2 [8L]

Fundamental Algorithmic Strategies: Brute-Force, Greedy,Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Module 3 [10L]

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Module 4 [10L]

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Text Books and/or Reference Material

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley

Course Outcomes:

CO1: For a given algorithm, analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

CO2: Describe the greedy, divide and conquer, and dynamic programming etc. Algorithmic paradigms and explain when these algorithmic design situations call for it.

CO3: For a given model engineering problem, model it using a graph and write the corresponding algorithm to solve the problems.

CO4: Explain the ways to analyze randomized algorithms (expected running time, probability of error).

Course Name: Artificial Intelligence & Machine Learning
Course Code: PCCCS405
Semester: 4
Contact Hours: L-T-P: 2-0-
0 Credits: 2

Prerequisite: Mathematics, Data Structure & Algorithms, Python

Module 1 [5L]

Introduction to Machine Learning

Data Preprocessing

Feature Engineering

Module 2 [8L]

Supervised Algorithm

Data holdout techniques

Classification algorithms

k-Nearest Neighbors

Decision tree

Naïve Bayes

Common regression

algorithms Model evaluation

Module 3 [3L]

Unsupervised Algorithm

K-Means

Module 4 [8L]

Basics of AI

Knowledge representation in AI

Knowledge deduction with

reasoning Production Systems

Problem formulation as search tree

Informed searching techniques (BFS and DFS)

Basics of Heuristic search

Learning

Text Books and/or Reference Material

1. Machine Learning by Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das

2. Machine Learning by Tom M. Mitchell

3. Artificial Intelligence by Rich and Elaine Rich, Kevin Knight, & Shivashankar B Nair

4. Artificial Intelligence: A modern approach by Stuart Russell, Peter Norvig

Course Outcomes (CO):

CO1: Students will be able to understand & design any data

CO2: Students will be able to implement and analyze various machine learning algorithms

CO3: Students will be able to represent knowledge using AI

CO4: Students will be able to learn and develop various applications of AI & ML Logistic regression algorithm

Course Name: Management 1 (Organizational Behaviour) Course Code: HSMC401
Semester: 4
Contact Hours: L-T-P: 3-0-0 Credits: 3

Module 1 [6L]

Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction

Module 2 [8L]

Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.

Module 3 [10L]

Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. Leadership: Definition, Importance, Theories of Leadership Styles.

Module 4 [8L]

Organizational Politics: Definition, Factors contributing to Political Behaviour. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.

Text Books and/or Reference Material

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.

2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.

3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI

4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.

5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10th Edn.

COURSE OUTCOMES (COs):

1. Understand the concepts, need and importance of management and application of the various principles of management.
2. Critically analyse and understand the process of management and the various components of the management process.
3. Understand adopt and integrate the individual behavior with the organizational behavior.
4. Acquainted with various components of individual behaviour and how it helps an organization in bringing in the organizational development and organizational effectiveness in the global orientation.

Course Name: Environmental Sciences Course Code: MC401
Semester: 4
Contact Hours: L-T-P: 2-0-0 Credits: 0

Module 1 [5L]

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering.

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

Module 2 [7L]

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth’s heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

Module 3 [7L]

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic

Module 4 [5L]

Lithosphere; Internal structure of earth, rock and soil Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, *L*10 (18hr Index) ,*n Ld*.Noise pollution control.

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.

Text Books and/or Reference Material

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House
(AICTE Recommended Textbook – 2018)

2. Masters, G. M., “Introduction to Environmental Engineering and Science”, Prentice-Hall of India Pvt. Ltd.,1991.

3. De, A. K., “Environmental Chemistry”, New Age International

Course Outcomes -

CO1: Be able to understand the natural environment and its relationships with human activities

CO2: Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.

CO3: Be able to understand environmental laws and regulations to develop guidelines And procedures for health and safety issues.

CO4: Be able to solve scientific problem-solving related to air, water, noise & land pollution

Course Name: Computer Organization and Architecture Lab
Course Code: PCCCS492
Semester: 4
Contact Hours: L-T-P: 0-0-
4 Credits: 2

Prerequisite: Digital Electronics Lab

1. HDL introduction **[2L]**

2. Basic digital logic base programming with HDL **[2L]**

3. 8-bit Addition, Multiplication, Division **[3L]**

4. 8-bit Register design **[2L]**

5. Memory unit design and perform memory operations **[4L]**

6. 8-bit simple ALU design **[2L]**

7. 8-bit simple CPU design **[4L]**

8. Interfacing of CPU and Memory **[3L]**

Course Name: Operating Systems
Lab Course Code: PCCCS493
Semester: 4
Contact Hours: L-T-P: 0-0-
4 Credits: 2

Module1 [4L]

Managing Unix/Linux Operating System

Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users & user groups.

Module2 [6L]

Process

starting new process, replacing a process image, duplicating aprocess image, waiting for a process, zombie process.

Signal

signal handling, sending signals, signal interface, signal sets.

Module3 [10L]

Semaphore

programming with semaphores (use functions semctl, semget,semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

Module4 [10L]

POSIX Threads

programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

Inter-process communication

pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory(IPC version V).

Course Outcomes:

CO1: To familiarize students with the architecture of Unix OS.

CO2: To provide necessary skills for developing and debugging programs in the UNIX environment.

CO3: To Simulate CPU Scheduling Algorithms. (FCFS, RR, SJF, Priority, Multilevel Queuing)

CO4: Students will be able to learn how to allocate the resources in an optimized manner.

Course Name: Design & Analysis of Algorithms Lab
Course Code: PCCCS494
Semester: 4
Contact Hours: L-T-P: 0-0-
4 Credits: 2

Module1 [8L]

Divide and Conquer:

1. Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2 .Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
3. Find the minimum number of scalar multiplication needed for chain of matrix
4. Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm)
Implement Traveling Salesman Problem
5. Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm)

Module2 [6L]

Brunch and Bound:

6. Implement 15 Puzzle Problem

Backtracking:

7. Implement 8 Queen problem
8. Graph Coloring Problem Hamiltonian Problem

Module3 [6L]

Greedy method:

9. Knapsack Problem Job sequencing with deadlines
10. Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm

Module4[4L]

Graph Traversal Algorithm:

11. Implement Breadth First Search (BFS). Implement Depth First Search (DFS)

Course Outcomes:

CO1: For a given algorithm, analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

CO2: Describe the greedy, divide and conquer, and dynamic programming etc. Algorithmic paradigms and explain when these algorithmic design situations call for it.

CO3: For a given model engineering problem, model it using a graph and write the corresponding algorithm to solve the problems.

CO4: Explain the ways to analyze randomized algorithms (expected running time, probability of error).

Course Name: Artificial Intelligence & Machine Learning Lab
Course Code: PCCCS495
Semester: 4
Contact Hours: L-T-P: 0-0-
2 Credits: 1

Prerequisite: Mathematics, Data Structure & Algorithms, Python

Module1 [8L]

Review of Python

Python libraries – numpy, pandas, matplotlib, seaborn, scikit-

learn Basic data manipulation, data exploration (using seaborn)

Introduction to Machine Learning [6L]:

Data Preprocessing

Feature Engineering

Module2 [6L]

Supervised Algorithm

Data holdout techniques

Classification algorithms

k-Nearest Neighbors

Decision tree

Naïve Bayes

Common regression

algorithms Model evaluation

Module3 [4L]

Unsupervised Algorithm

K-Means

Module 4 [6L]

Basics of AI

Problem formulation as search tree

Informed searching techniques (BFS and DFS)

Building 8 puzzle solver using Python

Course Outcomes (CO):

CO1: Students will be able to understand & design any data

CO2: Students will be able to implement and analyze various machine learning algorithms

CO3: Students will be able to represent knowledge using AI

CO4: Students will be able to learn and develop various applications of AI & ML Logistic regression algorithm

5th Semester

Course Name: Signals & Systems Course Code: ESC501
Semester: 5
Contact Hours: L-T-P: 3-0-0 Credits: 3

Module 1 (5L)

Signals and systems as seen in everyday life, and in various branches of engineering and science. Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift invariance, causality, stability, realizability.

Module 2 (5L)

Linear shiftinvariant (LSI) systems, impulse response and step response, convolution, input output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations

Module 3 (11L)

Periodic and semiperiodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The DiscreteTime Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.

Module 4 (11L)

Evolution of Transforms: Fourier Transform, Laplace Transform , Ztransform (single sided and Double sided) The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, , solution to differential equations and system behavior using Laplace Transformation The zTransform for discrete time signals and systemseigen functions, region of convergence, zdomain analysis.

Module 5 (4L)

The Sampling Theorem and its implications Spectra of sampled signals. Reconstruction: ideal interpolator, zeroorder hold, firstorder hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text Books and/or Reference Material

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Course Outcome:

CO1: To study and understand the basic characteristics and their mathematical representation of any general signals or a system and the applications of signals representation in real-life

CO2: To study and understand the representation and manipulation of signals and systems in terms of Laplace Transforms.

CO3: To study and understand the representation and manipulation of signals and systems in terms of Fourier series and Fourier Transforms.

CO4: To study and understand the representation and manipulation of signals and systems in terms of Z-Tranforms.

Course Name: Database Management
Systems Course Code: PCCCS501
Semester: 5
Contact Hours: L-T-P: 3-0-
0 Credits: 3
Prerequisite: Data Structure

Module 1 [6L]

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation Operations.

Module 2 [8L]

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Module 3 [8L]

Relational Database Design - Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF

Module 4 [4L]

Storage strategies: Indices, B-trees, hashing.

Module 5 [8L]

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi version and optimistic Concurrency Control schemes, Database recovery.

Module 6 [2L]

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Text Books and/or Reference Material

1. Stafano Ceri, "Distributed database concept", McGraw-Hill 2. A. Silberschatz, H. Korth, S. Sudarshan– " Database System Concepts (5^{th} Ed.)" – McGraw-Hill

Reference Books

1. G. K. Gupta, – "Database Management Systems (2nd Ed.)" – McGraw-Hill

2. Ramakrishnan: Database Management System , McGraw-Hill

Course Outcome:

CO1: Master the basic concepts and understand the applications of database systems..

CO2: Construct an Entity-Relationship (E-R) model from specifications and to transform to relational model. Construct unary/binary/set/aggregate queries in Relational Algebra.

CO3: Understand and apply database normalization principles & construct SQL queries to perform CRUD operations on the database. (Create, Retrieve, Update, and Delete).

CO4: Understand principles of database transaction management, database recovery, security and be aware of non-relational databases and applications. Understand file handling & storage management.

Course Name: Formal Language & Automata

Theory Course Code: PCCCS502

Semester: 5

Contact Hours: L-T-P: 3-0-

0 Credits: 3

Prerequisite: Data Structure

Introduction [6L]:

Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata [7L]:

Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Context free languages and pushdown automata [6L]:

Context free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context free languages, deterministic pushdown automata, closure properties of CFLs.

Context sensitive languages [6L]:

Context sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Undecidability [6L]:

Church Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

<u>Text Books and/or Reference Material</u>

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.10. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
2. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
3. John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill.

4. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Course Outcome:

CO1: Students will be able to define mathematical model of a system and recognize the behaviour of a system.

CO2: Students will be able to understand the regular expression.

CO3: Students will be able to understand the concept of grammar and language and apply the knowledge in compiler design.

CO4: Students would be able to understand the computability and complexity of a problem

Course Name: Object Oriented Programming

Course Code: PCCCS503

Semester: 3
Contact Hours: L-T-P: 3-0-0

Credits: 2

Prerequisite: Data Structure

Module 1[9L]

Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.

Module 2[9L]

Features of object-oriented programming. Encapsulation, object identity, polymorphism, Difference between OOP and other conventional programming – advantages and disadvantages. Basic concepts of Java programming – advantages of Java, byte-code & JVM, data types, access specifiers. Array, creation of class, object, constructor, Method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference. Static variables & methods, nested & inner classes, Basic string handling concepts- String, StringBuffer, mutable and immutable string, command line arguments, Basics of I/O operations
– keyboard input using BufferedReader & Scanner classes.

Module 3[12L]

Inheritance in OO design. Design patterns. Introduction and classification, Memory management, Process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, Use of abstract classes & methods, interfaces, Exception handling basics, Different types of exception classes, use of try & catch with throw, throws & finally, Creation of user defined exception classes, memory management, finalize and garbage collection, Design patterns. Introduction and classification. The iterator pattern, UML: Use case diagram, Class diagram, Sequence diagram, Collaboration diagram, Multithreading, Command, Commands as methods and as objects, Model-view-controller pattern

Module 4[6L]

GUIs. Graphical programming with Swing & Scala. Delegation event model and listener, layout manager (basic concept), creation of buttons (JButton class only) & text fields, Generic types and collections, Creation of packages, importing packages, member access for packages, The software development process.

Text Books and/or Reference Material

1. H. Schildt, “Java: The Complete Reference”, Tata McGraw Hill, 2017.

2. K. Sierra and B. Bates, Head First Java, O'reilly, 2005.

3. M. R. Blaha and J. R. Rambaugh, "Object-Oriented Modeling and Design With UML", Pearson, 2007.

4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING

5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson

6. Ivor Horton's Beginning Java 2 SDK – Wrox

7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Outcome:

CO1: Specify simple abstract data types and design implementations, using abstraction functions to document them.

CO2: Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.

CO3: Name and apply some common object-oriented design patterns and give examples of their use.

CO4: Design applications with an event-driven graphical user interface.

Course Name: Software Engineering

Course Code: PCCCS504

Semester: 5

Contact Hours: L-T-P: 2-0-0
Credits: 2

Prerequisite: Data Structure

Overview of System Analysis & Design, Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost Benefit Analysis, COCOMO model. [10L]

System Design – Context diagram and DFD, Problem Partitioning, TopDown And BottomUp design; Decision tree, decision table and structured English; Functional vs. ObjectOriented approach. [5L]

Coding & Documentation–Structured Programming, OOProgramming, Information Hiding, Reuse, System Documentation. [4L]

Testing Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification, Metrics, Monitoring & Control. [8L]

Software Project Management–Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. [7L]

Text Books and/or Reference Material

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. K.K. Aggarwal & Yogesh Singh, Software Engineering – (New Age International Publisher)

Course Outcome:

CO1: Understand and learn to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.

CO2: To apply current theories, models, and techniques that provides a basis for the software lifecycle.

CO3: Learn to work as an individual and as a part of a multidisciplinary team to develop and deliver quality software.

CO4: Learn to use the techniques and tools necessary for engineering practice.

Course Name: Humanities II (Principles of Management)

Course Code: HSMC501

Semester: 5

Contact Hours: L-T-P: 3-0-0

Credits: 3

Module 1 [8L]

1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.

2. Functions of Management: Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.

Module 2 [10L]

3. Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.

4. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.

5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship.

Module 3 [8L]

6. Leadership: Concept, Nature, Styles.

7. Decision making: Concept, Nature, Process, Tools & techniques.

8. Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.

Module 4 [6L]

9. Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management.

10. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.

Course Outcome:

CO1: Students would be able to evaluate and analyze professional ability

CO2: Students would be able to understand standard business principles and practices.

CO3: Students would be able to pick and choose the best business methods and strategies more professionally.

Course Name: Constitution of India/ Essence of Indian Knowledge Tradition Course

Code: MC501

Semester: 5

Contact Hours: L-T-P: 2-0-0

Credits: 0

Module1 [4L]

Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble,

Fundamental Rights and Duties, Directive Principles of State Policy.

Module2 [8L]

Union government and its administration: Structure of the Indian Union: Federalism,

Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. State government and its administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

Module3 [6L]

Supreme court: Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. High court: Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL.

Module4 [6L]

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Text Books:

1. Indian polity, M, Laxmikanth, MCGraw Hill education, 5th Edition.
2. DD Basu, "Introduction to the constitution of India", 21st Edition, Lexis Nexis BooksPublication ltd, India

Course Outcomes: After completion of this course, the learners will be able to -
CO1: Describe different features of the Indian constitution.
CO2: Power and functioning of Union, state and local self-government. Structure,jurisdiction and function of Indian Judiciary. Basics of PIL and guideline for admission ofPIL.
CO3: Functioning of local administration starting from block to Municipal Corporation.
CO4: Identify authority to redress a problem in the profession and in the society.

Course Name: Database Management Systems

Lab Course Code: PCCCS591

Semester: 5

Contact Hours: L-T-P: 0-0-4

Credits: 2

Prerequisite: Data Structure Lab

Structured Query Language

1. Creating Database [6L]

Creating a Database

Creating a Table

Specifying Relational Data Types

Specifying Constraints

Creating Indexes

2. Table and Record Handling [6L]

INSERT statement

Using SELECT and INSERT together DELETE,

UPDATE, TRUNCATE statements DROP,

ALTER statements

3. Retrieving Data from a Database [6L]

The SELECT statement

Using the WHERE clause

Using Logical Operators

in the WHERE clause

Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause, Using

Aggregate Functions, Combining Tables Using JOINS, Subqueries

4. Database Management [6L]

Creating Views

Creating Column Aliases

Creating Database Users

Using GRANT and REVOKE

Introduction to PL/SQL, Basic Stored Procedures and functions.

Stored Procedure Continued

Exceptions , Cursors, For Loop

Trigger , Sequence , Row ID, Rownum

<u>Text Books and/or Reference Material</u>

1. SQL Cookbook by Anthony Molinaro

2. Head First SQL: Your Brain on SQL -- A Learner's Guide Book by Lynn Beighley

3. SQL in 10 Minutes, Sams Teach Yourself (4th Edition) 4th Edition by Ben Forta

Course Outcome:

CO1: Students should be able to create Table with constraints and insert data.
CO2: Students should be able to write select queries both at row level and aggregate level.
CO3: Students should be able to write joins, insert, update and delete statements.
CO4: Students should be able to use PL/SqL blocks like functions, procedures, cursors and exception handling and students should be able to explain the need of views and how to create them. They should have an understanding of concepts like Row Id, Row Number.

Course Name: Object Oriented Programming

Lab Course Code: PCCCS593

Semester: 5

Contact Hours: L-T-P: 0-0-4

Credits: 2

Prerequisite: Data Structure Lab

1. Assignments on Java class, constructor, overloading, inheritance, overriding **[6L]**

2. Assignments on Java wrapper classes, arrays **[4L]**

3. Assignments on developing Java interfaces for multiple inheritances, extending interfaces **[2L]**

4. Assignments on creating and accessing Java packages **[2L]**

5. Assignments on Java multithreaded programming **[6L]**

6. Assignments on Java applet

programming **[4L]** **<u>Text Books and/or</u>**

<u>Reference Material</u>

1. Patrick Naughton, Herbert Schildt – “The complete reference-Java2” – TMH
2. R.K Das – “Core Java For Beginners” – VIKAS PUBLISHING
3. Deitel and Deitel –”Java How to Program” – 6th Ed. – Pearson
4. Ivor Horton’s Beginning Java 2 SDK – Wrox

Course Outcome:

CO1: Specify simple abstract data types and design implementations, using abstraction functions to document them.

CO2: Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.

CO3: Name and apply some common object-oriented design patterns and give examples of their use.

CO4: Design applications with an event-driven graphical user interface.

Course Name: Software Engineering

Lab Course Code: PCCCS594

Semester: 5

Contact Hours: L-T-P: 0-0-2

Credits: 1

Prerequisite: Data Structure Lab

Problem Analysis and Project Planning **[2L]**;

Thorough study of the problem **[1L];**

Identify Project scope, Objectives, and Infrastructure Software Requirement Analysis **[4L];**

Describe the individual Phases / modules of the project and Identify deliverables **[4L];**

Identify functional and non-functional requirements **[1L];**

Data Modelling **[1L];**

Use work products – data dictionary **[1L];**

Software Designing Develop use case diagrams and activity diagrams **[4L]**;

build and test class diagrams **[1L];**

sequence diagrams and add interface to class diagrams **[2L]**;
Prototype model–Develop the prototype of the product
[2L]; **<u>Text Books and/or Reference Material</u>**

1. Roger Pressman – "Software Engineering: A Practitioner's Approach" – McGraw-Hill Higher Education.

Course Outcomes (CO):

CO1 To understand the software engineering methodologies involved in the phases for project development.

CO2 To gain knowledge about open source tools used for implementing software engineering methods.

CO3 To exercise developing product-startups implementing software engineering methods.

CO4 Learn simple optimization techniques

Course Name: Advanced Algorithms Course Code: PECCS501A
Semester: 5
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Discrete Mathematics, Theory of Computation, Graph theory

Module 1 [7L]

Design Paradigms - Overview: Overview of Divide and Conquer, Greedy and Dynamic Programming strategies. Basic search and traversal techniques for graphs, Backtracking, Branch and Bound. Max Flow Problem, String Matching Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, Boyer-Moore algorithms and complexity analysis.

Module 2 [10L]

Theory of NP-Hard and NP-Complete Problems: P, NP and NP-Complete complexity classes; DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polynomial time algorithms: 2-satisfiability, 2-colourability. Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NP-completeness. Cook-Levin Theorem. Polynomial transformations: 3-satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness. DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE- completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NL- completeness. NL = coNL. Hierarchy of theorems.

Module 3 [10L]

Approximation Algorithms: Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms.

Parallel Algorithms: Introduction, Models, speedup and efficiency, Some basic techniques, Examples from graph theory, sorting, Parallel sorting networks. Parallel algorithms and their parallel time and processor complexity.

Module 4 [7L]

Probabilistic Algorithms & Randomized Algorithms: Numerical probabilistic algorithms, Las Vegas and Monte Carlo algorithms, Game-theoretic techniques, Applications on graph problems.

Text Books and/or Reference Material

Text Books

1. Introduction to Algorithms : T.H. Cormen, C.E.Leiserson and R.L. Rivest

2. Approximation Algorithms: Vijay V.Vazirani

3. Randomized Algorithms: R. Motwani and P.Raghavan

Reference Books

1. Introduction to the Theory of Computation, Michael Sipser, 3rd ed
2. Fundamentals of Algorithmics: G. Brassard and P. Bratley

Course Outcome:
CO1: Describe the greedy, divide and conquer, and dynamic programming etc. Algorithmic paradigms and explain when these algorithmic design situations call for it.
CO2: For a given algorithm, analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms and Study the complexity classes of problems.
CO3: Devise approximation and parallel algorithms for some NP Complete Problems.
CO4: Explain the ways to analyze randomized algorithms (expected running time, probability of error).

Course Name: Introduction to Data

Science Course Code: PECCS501B

Semester: 5

Contact Hours: L-T-P: 3-0-

0 Credits: 3

Module I: [8L]
Introduction: Introduction to Data Science – Evolution of Data Science – Data Science Roles
– Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Basic statistical and mathematical foundations for data science: Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis, Pivot Table, Correlation and Regression, ANOVA; Basic Probability for Data Science; Introductory hypothesis testing and statistical inference

Module II [8L]

Data acquisition, cleaning, and aggregation: Web scraping and data acquisition via APIs; Cleaning and reformating messy datasets using regular expressions, etc.; Data Integration and Transformation; Data Discretization.

Data pre-processing: Finding and remediating missing values; Finding and remediating outliers; Scaling and normalization; Handling categorical features.

Module III: [8L]

Exploratory data analysis and visualization: Box Plots; Pivot Table; Heat Map; Scatter plots; Residual Plot; Distribution Plot.

Feature engineering: Dimensionality reduction, including principal component analysis; Feature selection

Module IV: [12L]

Model creation and validation: Basic concept of learning; Supervised and unsupervised learning; Cross Validation; Overfitting and Under-fitting; Nearest Neighbour Algorithm; Decision Tree Learning and Random Forests; Clustering Analysis; Model evaluation; Generalization Error; Out-of-Sample Evaluation Metrics

End-to-end problem solution covering all the above aspects of Data Science

Text Books and/or Reference Material

1. Data Science From Scratch: First Principles with Python by Joel Grus
2. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools by Davy Cielen, Arno D.B. Meysman, Mohamed Ali
3. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
4. Han, J., Kamber, M., Pei, J., 2011, "Data Mining: Concepts and Techniques", Elsevier Science.
5. Murphy, K., 2012, "Machine Learning: A Probabilistic Perspective", MIT Press, Cambridge, MA.

Course Outcomes:

CO1. To review the basic prerequisite concepts of Data Science

CO2. To acquire concepts of data acquisition, cleaning and pre-processing

CO3. To acquire concepts data exploration and feature engineering

CO4. To acquire the basics of models and how to solve Data Science problems using the different models

Course Name: Advanced AI & Deep Learning

Code: PECCS501C

Semester: 5

Contact Hours: L-T-P: 3-0-0

Credits: 3

Prerequisite: Artificial Intelligence & Machine Learning

Module I [8L]

Search techniques: Traditional search techniques – BFS, DFS; Heuristic search strategies – Hill climbing, A* Search; evolutionary strategies; **Adversarial search** - Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Module II [7L]

Brief Review of Machine Learning: Types of machine learning; Process of machine learning, evaluating different ML models; Concept of loss function; Challenges faced by ML.

Feature engineering: Feature construction; Feature extraction; Feature selection.

Module III [7L]

Basics of Neural Network: Understanding biological neuron and artificial neuron; Types of activation functions; Architectures of neural network; Learning process in ANN.

Training Deep Neural Network: Backpropagation and mathematics behind it; Deep L-layer network; Computation graph; Weight initialization in neural network; Batch, mini-batch and stochastic gradient descent; Optimization algorithms; Regularization; Normalization.

Module IV [12L]

Convolutional Neural Network: Basic concept of computer vision; Challenges faced by traditional ANN to deal with image data; Convolutional neural network concepts – kernel, stride, padding, pooling; Building a CNN; Popular CNN architectures – LeNet, AlexNet, GoogLeNet, ResNet, Inception network, UNET; Object detection – bounding box, YOLO, landmark detection, Transfer learning.

Sequence Based Models: Introduction to sequence data; Recurrent neural network; Vanishing Gradient Problem and RNN; Long Short-term Memory (LSTM); Gated Recurrent Units (GRU); Bi-directional Models; Language modelling and Sequence models

Recommended books:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville

2. Deep Learning by Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra and Amlan Chakrabarti

3. Artificial Intelligence by Rich and Elaine Rich, Kevin Knight, & Shivashankar B Nair

4. Artificial Intelligence : A modern approach by Stuart Russell, Peter Norvig Pearson

Course Outcomes:

CO1. To have developed the basic concepts of AI and ML

CO2. To acquire concepts of machine learning algorithms

CO3. To acquire concepts related to deep neural network

CO4. To acquire concepts related to CNN and RNN

Course Name: Distributed Systems Course Code: PECCS501D
Semester: 5th
Contact Hours: L-T-P: 3-0-0
Credits: 2
Prerequisites: Computer Networks, Operating Systems

Module 1 [6L]

Distributed Systems Models

Client-Server model, Thin Client, Mobile Devices. Software agents. Fundamental models – Interaction, Failure and Security models.

Module 2 [10L]

Inter-process Communication

API for Internet protocols. External data representation and Marshalling. Client-Server communication and Group communication. Distributed Objects and Remote Invocation: Communication between distributed objects. Remote Procedure Call. Remote Object Invocation. Events and notification. Message and Stream-oriented communication. Case study: CORBA and DCOM.

Module 3 [9L]

Distributed File Systems

File service architecture. Sun NFS. Recent advances. Name Services: Basic principles of Name Services. Domain Name System. Directory and discovery services. Locating Mobile entities. Case studies. Coordination and Agreement: Distributed Mutual Exclusion. Elections. Consensus and related problems. Clock Synchronization

Module 4 [11L]

Transactions and Concurrency Control

Fundamental principles. Transactions and nested transactions. Locks. Optimistic concurrency control. Timestamp ordering. Distributed transactions – Flat and nested transactions. Atomic commit protocols. Concurrency control in distributed transactions. Distributed deadlocks. Transaction recovery. Distributed Snapshot Global State Collection Important Case Studies.

Text Books and/or Reference Material

Text Books

1. Distributed Systems: Concepts and Design - George Coulouris, Jean Dollimore, and Tim Kindberg.

2. Introduction to Reliable Distributed Programming - Rachid Guerraoui and Louis Rodrigues, Springer-Verlag, Berlin, Germany, 2006.

3. Distributed Systems: Principles and Paradigms - Andrew Tanenbaum and Maarten van Steen, Prentice Hall, 2007.

Reference Books

1. Elements of Distributed Computing - Vijay K. Garg, Wiley, 2002.

Course Outcomes:
CO1 Explain the distributed systems architecture.
CO2 Outline the inter process communication in distributed systems.
CO3 Explain the file accessing model and various services in distributed system.
CO4 Demonstrate concurrency control and properties of transaction in Distributed systems.

6th Semester

Course Name: Compiler Design

Course Code: PCCCS601
Semester: 6th
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Basic Computation & Principles of Computer Programming, Data structures and algorithms, Formal Language & Automata Theory

Module 1 [9L]

Overview of compilation & Lexical Analysis- The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs.

Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and ambiguity, examples of programming language grammars.

Module 2 [16L]

Top-down parsing- FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications.

Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, dependency graphs. S-attributed and L-attributed SDDs and their implementation using LR-parsers and recursive descent parsers respectively.

Module 3 [8L]

Semantic analysis- Symbol tables and their data structures. Representation of "scope". Semantic analysis of expressions, assignment, and control-flow statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery

Intermediate code generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it- then- else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs

Module 4 [12L]

Run-time environments:- Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures.

Introduction to machine code generation and optimization- Simple machine code generation, examples of machine-independent code optimizations.

Text Books and/or Reference Material

Text Books

1. Compilers: Principles, Techniques, and Tools , by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nd
ed.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.

Reference Books

Reference Books:
1. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.

2. D. Brown, J. Levine, and T. Mason, LEX and YACC, O‟Reilly Media, 1992.

Course Outcome:

CO1: Understand given grammar specification develop the lexical analyzer

CO2: Design a given parser specification design top-down and bottom-up parsers.

CO3: Develop syntax directed translation schemes.

CO4: Develop algorithms to generate code for a target machine.

Course Name: Computer
Networks Course Code: PCC-CS602
Semester: 6th
Contact Hours: L-T-P: 3-0-3
Credits: 3
Prerequisites:

Module 1 [8L]

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2 [10L]

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3 [12L]

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 4 [6L]

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Text Books and/or Reference Material

Text Books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.

2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Reference Books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Outcome:

CO1: Students should be able to master the terminology and concepts of the OSI reference model and the TCP-IP reference model

CO2: Students should be able to master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks

CO3: Students should be able to be familiar with wireless networking concepts

CO4: Students should be able to be familiar with contemporary issues in networking technologies, network tools and network programming

Course Name: Cloud Computing &
IoT Course Code: PCCCS603
Semester: 6
Contact Hours: L-T-P: 2-0-
0 Credits: 2
Prerequisites: Computer Networks

<u>Module 1 [10L]</u>

Introduction to Cloud Computing

Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing, Concepts of Abstraction and Virtualization. Case Studies.

<u>Module 2 [9L]</u>

Introduction to IoT

IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges, Introduction to Arduino Uno, NodeMCU, Raspberry Pi, Tinkercad. Case Studies.

<u>Module 3 [10L]</u>

IoT and the Cloud

Role of Cloud Computing in IoT – Thinkspeak Components, AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples and Case Studies.

Module 4 [9L]

Protocols and Security Issues
Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols, Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security, Case Studies.

Text Books and/or Reference Books

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013

3. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill

4. Cloud Computing, Miller, Pearson

5. Building applications in cloud : Concept, Patterns and Projects, Moyer, Pearson

6. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

7. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press.

8. Adrian McEwen, Designing the Internet of Things, Wiley, 2013.

Course Outcome:

CO1: Describe the fundamentals of Cloud and Internet of Things (IoT).

CO2: Interpret models of distributed and cloud computing.

CO3: Examine prototypes for Internet of Things (IoT).

CO4: Estimate the applications of IoT and cloud.

Course Name: Compiler Design
Lab Course Code: PCCCS691
Semester: 6th
Contact Hours: L-T-P: 0-0-
2 Credits: 2
Prerequisites: Basic Computation & Principles of Computer Programming, Data structures and algorithms, Formal Language & Automata Theory, Basics of C/C++

1. Familiarization with LEX by writing simple specifications for tokens such as, identifiers, numbers, comments in C/C++, etc. All LEX specifications must be compiled and executed with appropriate inputs. (**2 lab classes**)

2. LEX specification for tokens of the small language in ALSU‟s book (**1 lab class**)

3. Complete the specifications in (2) above to make a complete lexical analyzer. (**1 lab class**)

4. Familiarization with YACC by writing simple specifications for desk calculator, variable declarations in C (only numbers and array). All YACC specifications must be compiled and executed with appropriate inputs. Note that this exercise also requires LEX specifications o the tokens involved. (**2 lab classes**)

5. YACC specifications for the syntax of the small language in ALSU‟s book (**1 lab class**)

6. Adding error recovery to (5) above to make a complete parser. (**1 lab class**)

7. S-attributed specification of the semantics of the small language in ALSU‟s book to be incorporated into YACC specifications produced in (6) above. (**3 lab classes**)

8. Adding semantic error recovery to the semantic analyzer in (7) above to make a complete semantic analyzer. (**1 lab class**)

9. Intermediate code generation for the constructs of the small language in ALSU‟s book to be incorporated into the semantic analyzer of (8) above. (**3 lab classes**)

Text Books and/or Reference Material

Text Books

1. Compilers: Principles, Techniques, and Tools , by A.V. Aho, Monica Lam, Ravi Sethi, and J.D. Ullman, (2nd
ed.), Addison-Wesley, 2007 (main text book, referred to as ALSU in lab assignments).
2. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.

Reference Books

Reference Books:

1. K.C. Louden, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
2. D. Brown, J. Levine, and T. Mason, LEX and YACC, O‟Reilly Media, 1992.

COURSE OUTCOME:

CO1: Understand the practical approaches of how a compiler works.
CO2: Understand and analyze the role of syntax and semantics of Programming languages in compiler construction
CO3: Apply the techniques and algorithms used in Compiler Construction in compiler component design
CO4: To use different tools in construction of the phases of a compiler for the mini language

Course Name: Computer Networks
Lab Course Code: PCCCS692
Semester: 6
Contact Hours: L-T-P: 0-0-
4 Credits: 2
Prerequisites: Programming Languages

Module 1 [6L]

NIC Installation & Configuration (Windows/Linux)

Understanding IP address, subnet etc Familiarization with Networking cables (CAT5, UTP) Connectors (RJ45, T-connector), Hubs, Switches.

Module 2: [12L]

Routing and Switching: Routing Protocols, NAT, ACL, Frame Relay, VLAN.

Module 3 [9L]

TCP/UDP Socket Programming, TCP based, UDP based Multicast & Broadcast Sockets, Implementation of a Prototype Multithreaded Server.

Module 4 [9L]

Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window), Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check), Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N), Server Setup/Configuration, FTP, TelNet, NFS, DNS, Firewall.

Text Books and/or Reference

Material Text Books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Routing and Switching, Cisco Press

Reference Books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Outcome:

CO1: Specify simple abstract data types and design implementations, using abstraction functions to document them.
CO2: Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
CO3: Name and apply some common object-oriented design patterns and give examples of their use.
CO4: Design applications with an event-driven graphical user interface.

Course Name: Cloud Computing & IoT Lab
Course Code: PCCCS693
Semester: 6
Contact Hours: L-T-P: 0-0-
2 Credits: 1

List of Experiment

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.

2. Install Cloudsim and run some task scheduling algorithms

3. Install KVM (Kernel Virtual Machine) and test the interface

4. Build an IOT network with multi-sensor on a Tinkercad.

5. Build a IOT device/network multi-sensor data upload, retrieval and analysis system using NodeMCU and ThinkSpeak.

6. Build a single-node IOT data storage for IOT sub-networks connected via internet.

<u>Text Books and/or Reference Books</u>

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013

3. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill

4. Cloud Computing, Miller, Pearson

5. Building applications in cloud : Concept, Patterns and Projects, Moyer, Pearson

6. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

7. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press.

8. Adrian McEwen, Designing the Internet of Things, Wiley, 2013.

Course Outcome:

CO1: Describe the fundamentals of Cloud and Internet of Things (IoT).

CO2: Interpret models of distributed and cloud computing.

CO3: Examine prototypes for Internet of Things (IoT).

CO4: Estimate the applications of IoT and cloud.

Course Name: VLSI
Course Code: PECCS601A
Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Analog Electronic Devices, Graph Theory, Advanced Algorithms

Module 1 [10L]

Introduction to VLSI

Different levels of integration, a brief overview of VLSI Design Cycle.

Introduction to CMOS circuits

MOS Transistors, MOS transistor switches, CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers.

Processing Technology

Silicon Semiconductor Technology- an Overview, wafer processing, oxidation, epitaxy deposition, Ion-implantation and diffusion, The Silicon Gate Process- Basic CMOS Technology, basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator.

Module 2 [11L]

Programmable Logic Technology & VHDL Programming

Programmable Logic structure, Programmable interconnect, and Reprogrammable Gate Array: Xilinx Programmable Gate Array, Design Methods: Behavioural Synthesis, RTL synthesis; Case studies of basic digital circuits using VHDL; Case studies of integrating standard digital circuits into a processing module using VHDL.

Module 3

[9L] **Graph**

Theory

Planar graph; back edge, forward edge detection; Hamiltonian cycle; Chordal graph; Interval graph.

Advanced Algorithms

NP, NP hard, NP Complete problems; Approximation algorithm; Heuristic algorithm.

Module 4 [8L]

Placement and Routing

Placement: Min-cut based placement. Routing: Routing models, Channel Routing Problem and its objectives, channel routing algorithms.

Verification and Testing

Verification Versus Testing, Verification: timing verification, Testing concepts: failures - types of tests - FPGAs.

Text Books and/or Reference Books

1. "Digital Integrated Circuit", J.M.Rabaey, Chandrasan, Nicolic, Pearson
2. "CMOS Digital Integrated Circuit", S.M.Kang&Y.Leblebici, TMH
3. "Modern VLSI Design" Wayne Wolf, Pearson
4. "Digital design: with an introduction to the verilog HDL, VHDL, and system Verilog."M Morris Mano, Michael D. Ciletti.
5. "Algorithm for VLSI Design & Automation", N.Sherwani, Kluwer
6. *VHDL: programming by example*. Douglas L. Perry, McGraw-Hill Education,
7. " Digital Integrated Circuits" Demassa& Ciccone, Willey Pub.
8. "Modern VLSI Design: system on silicon" Wayne Wolf; Addison Wesley Longman Publisher
9. "Basic VLSI Design" Douglas A. Pucknell& Kamran Eshranghian; PHI
10. "CMOS Circuit Design, Layout & Simulation", R.J.Baker, H.W.Lee, D.E. Boyee, PHI

Course Outcome:
CO1: To study and understand various VLSI design technologies & process
CO2: To understand hardware description language programming
CO3: To study and understand algorithms related VLSI design
CO4: To understand routing, verification and testing of VLSI design

Course Name: Principles of Artificial Intelligence and Deep Learning
Code: PECCS601B

Semester: 6

Contact Hours: L-T-P: 3-0-0

Credits: 3

Prerequisite: Artificial Intelligenec & Machine Learning

Module I [10L]

Knowledge Representation: Representation of knowledge using First Order Logic; theorem proving and answer extraction. Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory. Introduction to Fuzzy sets; Different operators; Fuzzy relation; Fuzzy numbers; Fuzzy logic; Defuzzification;

Search techniques: Traditional search techniques – BFS, DFS; Heuristic search strategies – Hill climbing, A* Search; evolutionary strategies; **Adversarial search** - Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Module II [6L]

Brief Review of Machine Learning: Types of machine learning; Process of machine learning, evaluating different ML models; Concept of loss function; Challenges faced by ML.

Feature engineering: Feature construction; Feature extraction; Feature selection.

Module III [6L]

Basics of Neural Network: Understanding biological neuron and artificial neuron; Types of activation functions; Architectures of neural network; Learning process in ANN.

Training Deep Neural Network: Backpropagation and mathematics behind it; Deep L-layer network; Computation graph; Weight initialization in neural network; Batch, mini-batch and stochastic gradient descent; Optimization algorithms; Regularization; Normalization.

Module IV [12L]

Convolutional Neural Network: Basic concept of computer vision; Challenges faced by traditional ANN to deal with image data; Convolutional neural network concepts – kernel, stride, padding, pooling; Building a CNN; Popular CNN architectures – LeNet, AlexNet, GoogLeNet, ResNet, Inception network, UNET; Object detection – bounding box, YOLO, landmark detection, Transfer learning.

Sequence Based Models: Introduction to sequence data; Recurrent neural network; Vanishing Gradient Problem and RNN; Long Short-term Memory (LSTM); Gated Recurrent Units (GRU); Bi-directional Models; Language modelling and Sequence models

Recommended books:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville

2. Deep Learning by Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra and Amlan Chakrabarti

3. Artificial Intelligence by Rich and Elaine Rich, Kevin Knight, & Shivashankar B Nair

4. Artificial Intelligence : A modern approach by Stuart Russell, Peter Norvig Pearson

Course Outcomes:

CO1. To have developed the basic concepts of AI and ML.

CO2. To acquire concepts of machine learning algorithms,

CO3. To acquire concepts related to deep neural network.

CO4. To acquire concepts related to CNN and RNN.

Course Name: Computer Graphics Course Code: PECCS601C
Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Mathematics, Physics, Basic Principles of C Programming, Design & Analysis of Algorithm

Module 1 [10L]

Introduction to Computer Graphics & Graphics Systems

Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3Dviewing devices, etc.; Active & Passive graphics devices; Computer graphics software.

Scan Conversion

Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; Scan line polygon fill algorithm, boundary fill algorithm, flood fill algorithm.

Module 2 [10L]

2D Transformation & Viewing

Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; Reflection, shear; Transformation of points, lines, parallel lines, intersecting lines.

Viewing pipeline: Window to viewport coordinate transformation, Clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland- Hodgeman Polygon clipping, Cyrus-beck clipping method.

3D Transformation & Viewing

3D transformations: translation, rotation, scaling & other transformations. General parallel projection transformation: clipping, viewport clipping, 3D viewing.

Module 3

[10L] Curves

Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden Surfaces

Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal-geometry.

Module 4 [5L]

Color & Shading Models

Light & color model: inter polative shading model; Texture.

Introduction to Ray-tracing

Human vision and color: Lighting, Reflection and transmission models.

Text Books and/or Reference Material

Text Books:

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4. Mukherjee – "Fundamentals of Computer graphics & Multimedia", PHI
5. Buford J. K. – "Multimedia Systems" – Pearson Education
6. Mukherjee Arup – "Introduction to Computer Graphics", Vikas

7. Hill – "Computer Graphics using open GL", Pearson Education
8. Hearn, Baker, Carithers – "Computer Graphics with open GL", Pearson Education

Reference Books:

1. Foley, Vandam, Feiner, Hughes – "Computer Graphics principles (2nd Ed.)" – Pearson Education.
2. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – TMH.

Course Outcome:
CO1: Knowledge about graphics systems. Make raster scan conversion and filling of basic geometric objects
CO2: Understand different geometric transformations of 2D/3D graphics-objects.
CO3: Understand different viewing and clipping methods and visible surface detection.
CO4: Understand 3D object representation through Bezier, B-Spline, illumination models, ray tracing, color model.

Course Name: Cyber Security
Course Code: PECCS601D
Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Computer Networks

<u>Module 1 [6L]</u>
Introduction to Cyber Security
Overview of Cyber Security, Internet Governance, Cyber Threats: Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

<u>Module 2 [10L]</u>
Cyber Security Vulnerabilities and Cyber Security Safeguards
Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Deception, Denial of Service Filters, Ethical Hacking, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

<u>Module3 [10L]</u>
Securing Web Application, Services, Servers, Intrusion Detection and Prevention Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

Module 4 [10L]

Network Security, Cyberspace and the Law, Cyber Forensics

User Management, VPN Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec. Introduction to Cyberspace Law, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace National Cyber Security Policy 2013. Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk- based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Text Books and/or Reference Material

Text Books

1. W.A.Coklin, G.White, Principles of Computer Security: Fourth Edition, McGrawHill, 2016
2. Thomas Halt, Adam M. Bossler and Kathryn C.Seigfried Spellar, —Cybercrime and Digital Forensics: An Introduction, Routledge Taylor and Francis Group 2017.
3. Michael T. Simpson, Kent Backman, James Corley —Hands-On Ethical Hacking and Network Defense, 2016
4. Atul Kahate, —Cryptography and Network Security, Tata McGraw-Hill, 2003.

Reference Books

1. Daswani N., Kern C., Kesavan A., Foundations of Security, Apress, 2007

2. Bernadette H Schell, Clemens Martin, —Cybercrime, ABC – CLIO Inc, California, 2004

Course Outcomes:

CO1: Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.
CO2: Design, develop, test and evaluate secure software.
CO3: Develop policies and procedures to manage enterprise security risks.
CO4: Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.

Course Name: Graph
Theory Course Code:
PECCS602A Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Discrete Mathematics

Module 1 [9L]

Preliminaries: Graphs, isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences, Walks, trails, paths, connected graphs, distance, cut vertices, cut edges, blocks, weighted graphs, connectivity, Dijkstra's shortest path algorithm, Floyd Warshall shortest path algorithm.

Module 2 [10L]

Special classes of graphs: Characterizations, number of trees, minimum spanning trees; Characterizations, number of trees, minimum spanning trees; Bipartite graphs, line graphs, chordal graphs; Eulerian graphs; Characterization, Fleury's algorithm, chinese-postman-problem; Hamilton graphs; Necessary conditions and sufficient conditions, Interval graph.

Module 3 [5L]

Coloring: Basic equations, matchings in bipartite graphs, perfect; Vertex-colourings; Chromatic numberand cliques, greedy coloring algorithm, coloring of chordal graphs, Brook'stheorem; Edge-colorings.

Module 4 [8L]

Planar graphs, Directed graphs: Basic concepts, Eulers formula, polyhedrons and planar graphs, charactrizations, planarity testing, 5-color-theorem; Directed graph, underlying graph, out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments.

Text Books and/or Reference Material

Text Books

1. J.A. Bondy and U.S.R.Murty: Graph Theory and Applications

2. D.B.West: Introduction to Graph Theory, Prentice-Hall of India/Pearson, 2009

Reference Books

1. J.A.Bondy and U.S.R.Murty: Graph Theory, Springer, 2008

2. R.Diestel: Graph Theory, Springer 2000.

Course Outcomes (CO):

CO1: Demonstrate the knowledge of fundamental concepts in graph theory, including properties and characterization of graphs and trees.

CO2: Use graphs for solving real life problems.

CO3: Distinguish between planar and non-planar graphs and solve problems.

CO4: Develop efficient algorithms for graph related problems in different domains of engineering and science.

Course Name: Soft
Computing Course Code:
PECCS602B Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Artificial

Intelligence **Module I [4L]**

Introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm

Module II [14L]

Fuzzy sets and Fuzzy logic systems: Classical Sets and Fuzzy Sets and Fuzzy relations : Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations.

Membership functions : Features of membership functions, standard forms and boundaries, different fuzzification methods.
Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods.
Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models.
Introduction to Rough Sets, Set Approximation, Rough Membership, Application of Rough sets.

Module III [12L]
Neural Network

Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron.
Learning Methods : Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Backpropagation and multi layer networks.
Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks.
Neuro-Fuzzy modelling:Applications of Neural Networks: Pattern Recognition and classification.

Module IV [12L]

Genetic Algorithms: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition.

Text Books and/or Reference Material

1. Fuzzy logic with engineering applications, Timothy J. Ross, John
2. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Wiley and Sons.
3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH
7. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
8. A beginners approach to Soft Computing, Samir Roy & Udit Chakraborty, Pearson
9. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
10. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.

Course Outcomes:

CO1. To have developed the basic concepts of soft computing techniques.

CO2. To acquire and apply the concepts of fuzzy sets, fuzzy logic and rough sets.

CO3. To acquire concepts of artificial neural network.

CO4. To acquire and apply concepts of Genetic Algorithm.

Course Name: Web and Internet Technology
Course Code: PECCS602C
Semester: 6
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Basics of Programming

Module 1 [6L]

Introduction

Overview, Network of Networks, Intranet, Extranet, and Internet. World Wide Web, Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP.

TCP/IP

Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing - Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables.

Routing Protocol

Routing - Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast, Electronic Mail Protocol - POP3, SMTP.

Module 2

[9L] **HTML**

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.

Image Maps

Map, area, attributes of image area.

Extensible Markup Language (XML)

Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.

CGI Scripts

Introduction, Environment Variable, GET and POST Methods.

Module 3 [10L]

PERLIntroducti on, Variable, Condition, Loop, Array, Implementing data structure, Hash,

String, Regular Expression, File handling, I/O handling.

JavaScript

Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object - string, array, Boolean, reg-ex. Function, Errors, Validation.

Cookies

Definition of cookies, Create and Store a cookie with example.

Java Applets

Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.

Module 4 [12L]

Client-Server programming In Java

Java Socket, Java RMI.

Threats

Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.

Network security techniques

Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH).

Firewall

Introduction, Packet filtering, Stateful, Application layer, Proxy.

Internet Telephony

Introduction, VoIP.

Multimedia Applications

Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV.

Search Engine and Web Crawler

Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Text Books and/or Reference Books

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI learning, Delhi, 2013.

2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.

Course Outcome:

CO1: Students will be able to understand basic communication.

CO2: Students will be able to understand the concept of network and internet.

CO3: Students will be able to learn the client and server side.

CO4: Students will be able to learn the security of the network too.

Course Name: Digital Forensics Course Code: PECCS602D Semester: 6
Contact Hours: L-T-P: 3-0-0
Credits: 3

Prerequisites: Computer

Networks <u>Module 1 [6L]</u>

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

Module 2 [8L]

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery workstation and software, conducting and investigations.

Module 3 [8L]

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

Module 4 [14L]

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case. Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

Text Books and/or Reference

Material Text Books

1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.

2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

Reference Books

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Course Outcomes:
CO1: Understand the definition of computer forensics fundamentals.
CO2: Evaluate the different types of computer forensics technology
CO3: Analyze various computer forensics systems.
CO4: Apply the methods for data recovery, evidence collection and data seizure

Course Name: Quantum Computation and Quantum
Information Course Code: OECCS601A
Semester: 6

Contact Hours: L-T-P: 3-0-
0 Credits: 3
Prerequisites: Data Structure and Algorithm, Linear algebra, Calculus

Module 1 [6L]

Introduction to Quantum Computing: Motivation for studying Quantum Computing, Major players in the industry, Origin of Quantum Computing; Overview of major concepts in Quantum Computing (Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement)

Module 2 [6L]

Math Foundation for Quantum Computing: Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

Module 3 [10L]

Building Blocks for Quantum Program: Architecture of a Quantum Computing platform; **Details of q-bit system of information representation:** Block Sphere Multi-qubits States; Quantum superposition of qubits (valid and invalid superposition); Quantum Entanglement; Useful states from quantum algorithmic perceptive e.g. Bell State; Operation on qubits: Measuring and transforming using gates; Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled, gates, Ising, Deutsch, swap. **Programming model for a Quantum Computing Program**: Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits. **]**

Module 4 [12L]

Quantum Algorithms: Basic techniques exploited by quantum algorithms; Amplitude amplification; Quantum Fourier Transform; Phase Kick-back; Quantum Phase estimation; Quantum Walks; **Major Algorithms:** Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm.

Text Books and/or Reference Material

Text Books

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.

2. David McMahon, "Quantum Computing Explained", Wiley

3. P. Kaye, R. Laflamme, and M. Mosca. *An Introduction to Quantum Computing*. Oxford, 2007.

Reference Books

1. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008

2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995.

Course Outcomes (CO): On successful completion, students will gain understanding of

CO1: The basic principles of quantum computing.

CO2: The fundamental differences between conventional computing and quantum computing.

CO3: Several basic quantum computing algorithms.

CO4: The classes of problems that can be expected to be solved well by quantum computers.

7th Semester

Course Name: Network Security & Cryptography Course Code: PCCCS701
Semester: 7
Contact Hours: L-T-P: 2-0-0 Credits: 2
Prerequisite: Computer Network

<u>Module1 [12L]</u>

Introduction to Cryptographic Tools: Security Goals, Threats, Vulnerabilities and Attacks, Types of Attacks, Security Services and Mechanisms, Symmetric Key Cryptography, Block Ciphers, Stream Ciphers, DES, IDEA, AES, Asymmetric Key Cryptography, RSA, ElGamal Cryptosystems, Elliptic Curve Cryptosystems, Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signatures, Key Management, Kerberos.

<u>Module2 [12L]</u>

Security at different Network Layers : IP Security Overview, IP Security Architecture, Security Association, Authentication Header, Encapsulated Security Payload, Internet Key Exchange, SSL

Architecture, Four SSL Protocols, SSL Message Format, Transport Layer Security, HTTPS, SSH, Email Security, PGP, S/MIME.

Module3 [8L]

Firewalls and Intrusion Detection and Prevention Systems: Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configuration, Intrusion Detection Systems: Intruders, Intrusion Detection, Host Based Intrusion Detection, Network Based Intrusion Detection, Distributed Intrusion Detection, Intrusion Detection Exchange Format, Honeypots, Intrusion Prevention Systems.

Module1 [8L]

Malicious Software and Software Security: Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Bots, Botnets, Rootkits, Buffer Overflow Attacks, Defence against Buffer Overflows, Handling Program Inputs, Writing Safe Program Codes, Interaction with Operating System and Other Software.

Text Books and/or Reference Material

1. Computer Security: Principles and Practices, by William Stallings and Larry Brown, First Edition, 2008, Pearson Education

2. Network Security: Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Second Edition, 2003, Prentice Hall India 21

3. Cryptography and Network Security, by William Stallings, Fifth Edition, , Prentice Hall, 2010

4. Cryptography and Network Security by Behrouz A. Forouzan and Debdeep Mukhopadhyay, Second Edition, 2010, Tata McGraw Hill

5. Network Security Essentials: Applications and Standards, by William Stallings, Edition, , Pearson Education

6. Security in Computing, by Charles P. Pfleeger, Shari Lawrence Pfleeger, 4th Edition, 2007, Prentice Hall

Course Outcomes:
CO1: Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.
CO2: Design, develop, test and evaluate secure software.
CO3: Develop policies and procedures to manage enterprise security risks.
CO4: Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.

Course Name: Embedded
Systems Course Code: PECCS701A
Semester: 7
Contact Hours: L-T-P: 3-0-0
Credits: 3

Prerequisites: Analog Electronic Circuits, Digital Electronics

Module 1 [10L]

8051 Microcontroller Architecture

8051 Micro Controller: Hardware Architecture, pintouts - Functional Building Blocks of Processor - Memory organization -I/O ports and data transfer concepts- Timing Diagram - Interrupts.

Microcontroller Programming

Instruction format and addressing modes, assembly language format - Data transfer, data manipulation & control instructions - Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions - stack. I/O instructions - Simple programming exercises key board and display interface.

Module 2 [6L]

Introduction to Embedded System

Embedded system VS General computing systems, Purpose of Embedded systems, Design challenge - optimizing design metrics, embedded processor technology, Microprocessor and Microcontroller, Hardware architecture of the real time systems. A/D converter and D/A Converter, RISC vs CISC, Example of Embedded system.

Module 3 [10L]

AVR Microcontroller: Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register, Port Registers (PORTx), PWM registers (8-bit), ADC registers, basics of communication, overview and interfacing I/O devices with I2C Bus, UART and Serial Peripheral Interchange (SPI) bus, Programming Embedded Systems with AVR (Arduino API)

Case Studies:

Interfacing with LDR sensor. Interfacing with analog and digital temperature sensor; Interfacing with ultra-sonicsensor; Interfacing with flexsensor; Interfacing with gas sensor; Interfacing with motor;

Module 4 [10L]

ARM microcontroller: Architecture of ARM Embedded microcontroller, ARM instruction set, Introduction to ARMv8-A based embedded development board (i.e. Raspberry Pi rev.4), Programming a Raspberry Pi rev.4 using Python 2.7, User defined LED blink using Raspberry Pi GPIOs, communication between an Arduino UNO rev.3 with Raspberry Pi 4 over USB serial.

Case Studies:

Interfacing with analog and digital temperature sensor; Interfacing with ultra-sonicsensor; Interfacing with flexsensor; Interfacing with motor;Interfacing with camera;

Text Books and/or Reference Material

1. Mohamed Ali Mazidi, Janice GillispieMazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
2. Raj Kamal, Embedded systems- Architecture, Programming and Design, McGraw Hill Education (India) Pvt. Ltd.
3. Dhananjay Gadre, “Programming and Customizing the AVR Microcontroller”; McGraw Hill Education, 2014.
4. Elliot Williams, “AVR Programming: Learning to Write Software for Hardware”, Maker Media, Incorporated, 2014
5. An Embedded Software Primer - David E. Simon, Pearson Ed., 2005.

Course Outcome:
CO1: To study and understand 8051 microcontroller architecture & programming
CO2: To understand general embedded systems architecture and related concepts
CO3: To study and understand ATmega 328 microcontroller architecture & programming
CO4: To study and understand Raspberry Pi architecture & programming

Course Name: Data Mining Course Code: PECCS701B Semester: 7
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites:Data Structure and Algorithm, Mathematics and Statistics III

<u>Module 1 [4L]</u>
Data Design - Design decisions, Basics of Dimensional modeling, E-R modeling versus Dimensional modeling; The STAR schema - illustration, Dimension Table, Fact Table, Factless Fact Table, Data granularity STAR schema keys - Primary, Surrogate, and Foreign; Advantages of the STAR schema, STAR schema examples

Module 2 [5L]

Overview of ETL, Requirements of ETL and steps; Data extraction - identification of sources and techniques; Data transformation - Basic tasks, Transformation types, Data integration and consolidation, Transformation for dimension attributes; Data loading - Techniques and processes, Data refresh versus update, Procedures for Dimension tables, Fact tables : History and incremental loads; ETL Tool options

Importance of data quality, Challenges for data quality, Data quality tools, Data cleansing and purification, Master Data Management

Module 3 [6L]

Information from Data warehouse versus Operational systems, Users of information - their needs and how to provide information; Information delivery - queries, reports, analysis, and applications; Information delivery tools - Desktop environment, Methodology and criteria for tool selection, Information delivery framework, Business Activity Monitoring, Dashboards and Scorecards; Web-enabled Data Warehouse - adapting data warehouse for the web; Web-based information delivery - Browser technology for data warehouse and Security issues OLAP and Web - Enterprise OLAP, Web-OLAP approaches, OLAP Engine design

Module 4 [11L]

Overview of Data mining - Definition, Knowledge Discovery Process (Relationships, Patterns, Phases of the process), OLAP versus Data mining; Some aspects of Data mining - Association rules, Outlier analysis, Predictive analytics etc) Concepts of Data mining in a Data warehouse environment; Major Data Mining techniques - Cluster Detection, Decision Trees, Memory-based Reasoning, Link Analysis, Neural Networks, Genetic Algorithms etc

Data Mining Applications in industry - Benefits of Data mining, Discussion on applications in Customer Relationship Management (CRM), Retail, Telecommunication, Biotechnology, Banking and Finance etc

Text Books and/or Reference Material

1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India

2. Data Warehousing, Data Mining, & OLAP - Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education

3. Data warehouse Toolkit by Ralph Kimball, Wiley India

Course Name: Image Processing

Course Code: PECCS701C
Semester: 7
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Computer Graphics

Module 1 [5L]

Introduction

Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.

Module 2 [14L]

Digital Image Formation

A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Mathematical Preliminaries

Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module 3 [15L]

Image Enhancement Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Image Smoothing; Image Sharpening; Image Filtering.

Image Segmentation Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Module 4 [7L]

Image Restoration Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.

Text Books and/or Reference Material

1. Digital Image Processing, Gonzalves,Pearson

2. Digital Image Processing, Jahne, Springer India

3. Digital Image Processing & Analysis,Chanda & Majumder,PHI

4. Fundamentals of Digital Image Processing, Jain, PHI

5. Image Processing, Analysis & Machine Vision, Sonka, VIKAS

6. Getting Started with GIS- Clarke Keith. C; PE.

7. Concepts & Techniques of GIS - Lo C.P, Albert, Yeung K.W- PHI.

Course Outcomes (CO):

CO1: Remember the fundamental concepts of image processing.

CO2: Capable to explain different image enhancement techniques

CO3: Understand and review image transforms model.

CO4: Analyze the basic algorithms used for image processing and image compression with morphological image processing. Design and Synthesize Color image processing and its real world applications.

Course Name: Mobile Computing Course Code: PECCS701D Semester: 7
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Computer Networks

Module 1 [10L]

Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

Module 2 [14L]

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies. Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

Module 3 [6L]

Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.

Module 4 [6L]

Server-side programming in Java, Pervasive web application architecture, Device independent example application

Text Books and/or Reference Material

Text Book:

1. "Pervasive Computing", Burkhardt, Pearson

2. "Mobile Communication", J. Schiller, Pearson

3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001

4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.

Reference Book:

1. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.

2. "Wireless Web Development", Ray Rischpater, Springer Publishing,

3. "The Wireless Application Protocol", Sandeep Singhal, Pearson.

4. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers.

Course Outcomes:

CO1: Analyze the various wireless communication technologies.

CO2: Visualize the various important steps in GSM communication

CO3: Analyze the mobile IP and Transport Protocol.

CO4: Enables the students to examine the important aspects of Mobile Adhoc Networks

Course Name: Real Time Operating Systems
Course Code: PECCS702A
Semester: 7
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Operating Systems

Module 1 [5L]

Introduction to OS

Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling.

Module 2 [10L]

Introduction to RTOS

Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel, Modelling Timing Constraints.

Module 3 [10L]

Real-Time Task Scheduling

Task Management & Memory Management, Scheduling Strategies: Schedulers, Run to Completion (RTC) Scheduler, Round Robin (RR) Scheduler, Time Slice (TS) Scheduler, Priority Scheduler, Composite Scheduler, Cyclic Schedulers, Rate-Monotonic Scheduling, Event-Driven Scheduling.

Module 4 [5L]

Related Topics in RTOS

Basic requirements and basic issues in RTOS, Real-Time Communications, Open Source and Commercial RTOS.

Text Books and/or Reference Material

Text Books

1.J. J Labrosse, “MicroC/OS-II: The Real –Time Kernel”,Newnes, 2002.

2. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000.

3. Rajiv Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India.

Reference Books

1. Philips A. Laplante, “Real-Time System Design and Analysis”,3rd Edition, John Wley& Sons, 2004

CO1: Explain the fundamentals of interaction of OS with a computer and User computation
CO2: Explain the fundamental concepts of how process are created and controlled with OS
CO3: Compare types and Functionalities in commercial OS
CO4: Application development using RTOS

Course Name: Natural Language Processing Course Code: PECCS702B

Semester: 7

Contact Hours: L-T-P: 3-0-0 Credits: 3

Prerequisites: Data Structure and Algorithms and Formal Language and Automata Theory

Module I [8L]

Introduction: Natural Language Processing - Problems and perspectives
Information Extraction and Named Entity Recognition, Text processing, Corpora and their construction
Regular Expressions and Tokenization: Regular Expression, Finite State Automata, Grammars for natural language, Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Minimum Edit Distance, Computational Morphology, Morphological operations

Module II [8L]

Language Modeling: Introduction to N-grams, Chain Rule, and Part of Speech Tagging – Rule based and Machine Learning based approaches

Computational Lexical Semantics: Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity

Module III: [10L]

Text Classification: Text Classification, Naïve Bayes’ Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques

Information Retrieval: Boolean Retrieval, Term-document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval, Term Frequency, Inverse Document Frequency based ranking

Module IV [6L]

Applications: Sentiment Analysis, Topic modeling, Summarization, Recommendation System, and Chatbot

Text Books and/or Reference Material

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
3. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
4. Radford, Andrew et. al., Linguistics, An Introduction, Cambridge University Press, 1999.
5. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press

Course Outcomes (CO):

CO1: Develop a broad understanding of the field of natural language processing

CO2: Develop a sense of the capabilities and limitations of current natural language technologies, and some of the algorithms and techniques that underlie these technologies

CO3: Evaluate language technology components

CO4: Familiarize with a sample of machine learning techniques and can assess which ones are suitable for a given problem and able to explain the interaction between rule based and probabilistic methods in language technology

Course Name: Principles of Computer Vision
Course Code: PECCS702C
Semester: 7
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Computer Graphics, Basics of Machine Learning programming

Module 1 [8L]

Introduction to Image acquisition and processing

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre- processing and Binary image analysis, image filters and transforms.

Module 2 [11L]

Detection of objects

Edge detection, Edge detection performance, Hough transform, corner detection, Segmentation, Morphological filtering, Fourier transform, Case studies on still-image object detection and video-frame base object detection and tracking.

Module 3 [8L]

Image pre-processing and analysis

Feature extraction, shape, histogram, color, spectral, texture using CVIPtools; Feature analysis, feature vectors, distance /similarity measures, data pre-processing; Case studies on computational photography;

Module 4 [11L]

Machine Learning

Pattern Analysis, Classification - Discriminant Function, Supervised, Un-supervised, Semi-supervised; Clustering - K-Means, K-Medoids, Mixture of Gaussians; Classifiers - Bayes, KNN, ANN models; Dimensionality Reduction - PCA, LDA, ICA, and Non-parametric methods. Case studies on activity recognition, biometrics.

Text Books and/or Reference Material

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Pearson.

2. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer.

3. Programming Computer Vision with Python: Tools and algorithms for analyzing images, Jan Eri Solem, O'Reilly

4. Deep Learning, by Goodfellow, Bengio, and Courville.
5. Dictionary of Computer Vision and Image Processing, by Fisher et al.

Course Outcome:
CO1: To understand and apply technologies, process and algorithms in image acquisition
CO2: To understand and apply technologies, process and algorithms for detection of objects within images
CO3: To understand and apply technologies, process and algorithms for image pre-processing and analysis of images
CO4: To understand and apply technologies, process and algorithms in ML in relation to computer vision

Course Name: Introduction to BlockChain Course Code: PECCS702D
Semester: 7
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Computer Networks

Module 1 [8L]

Introduction to Blockchain: Basic Idea, History, Architecture, Conceptualization, Basic Crypto-currency Primitives (Bitcoin, Ether), Types of Blockchain, Introduction to Mining. Pros and Cons of Blockchain Technology, Concept of Tokenization

Module 2 [8L]

Consensus Mechanism: Basic Concept, PoW, PoS, DPoS, PoET, PoA, RAFT, Byzantine General's Problem, Practical Byzantine Fault Tolerance, Algorand

Module 3 [8L]

Smart Contract: Introduction to ethereum and hyperledger architecture, Smart Contract design and concept with respect to both these architctures.

Module 4 [12L]

Privacy, Security issues in Blockchain and Various application areas of blockchain:Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these, Blockchain application areas

Text Books and/or Reference Material

Text Books

1. "Mastering Bitcoin" by Andreas Antonopoulos
2. "The Internet of Money, Volumes 1 - 3" by Andreas Antonopoulos
3. "The Bitcoin Standard" by Saifedean Ammous

Reference Books

3. Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019
4. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

Course Outcomes:
CO1: List and describe differences between proof-of-work and proof-of-stake consensus.
CO2: Interact with a blockchain system by sending and reading transactions.
CO3: Design, build, and deploy a distributed application.
CO4: Evaluate security, privacy, and efficiency of a given blockchain system.

Course Name: Enterprise
Systems Course Code: OECCS701A
Semester: 7
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Database Management System

Module 1[8L]

Information System: Components of an information system; Different types of information systems; Management information system, Enterprise Resource Planning: Business modelling; Integrated data model

Introduction to ERP: Defining ERP, Origin and Need for an ERP System, Benefits of an ERP System, Reasons for the Growth of ERP Market, Reasons for the Failure of ERP Implementation: Roadmap for successful ERP implementation

Module 2[8L]

ERP and Related Technologies: Organizational Change and Business Process Re- engineering, Procurement Process, Production Process, Management Information systems, Decision Support Systems, Executive Information Systems- Advantages of EIS; Disadvantages of EIS, Data Warehousing, Data Mining, On-Line Analytical Processing

Module 3[8L]

ERP Implementation Life Cycle: ERP Tools and Software, ERP Selection Methods and Criteria, ERP Selection Process, ERP Vendor Selection, ERP Implementation Lifecycle, Pros and cons of ERP implementation, Factors for the Success of an ERP Implementation

Module 4[10L]

ERP Extensions: An CRM Perspective: Role of ERP in CRM, Concept of CRM: Objectives of CRM; Benefits of CRM; Components of CRM, Types of CRM: Operational CRM, Analytical CRM, Sales intelligence CRM, Collaborative CRM, Sub-Modules of CRM: Marketing module; Service module; Sales module

An SCM Perspective: The basics of supply chain management (SCM); analyses of roles and objectives of supply chain management. the flows of supply chain management and data warehouses. descriptions and analyses of supply chain integration. The role of Information Technology in supply chain management

Text Books and/or Reference Material

1. ERP: Making It Happen By (author)Thomas F. Wallace Michael H. Kremzar

2. Enterprise Systems for Management By (author) Luvai F. Motiwalla , Jeff Thompson

3. Enterprise Resource Planning Systems -Systems, Life Cycle, Electronic Commerce, and Risk By (author) Daniel E. O'Leary, University of Southern California

8th Semester

Course Name: Social Network Analysis Course Code: OECCS801A
Semester: 8
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Data Structure and Algorithm, Graph theory

Module 1 [6L]

Introduction & Why Social Media Analytics Matter

• Introduction to social network analytics • Social network basics and metrics • Aspects of networks • Key concepts and measures in network analysis • Network representation • Information Networks and the World-Wide Web • The Emergence of Web 2.0 • Blogs and online communities • Structure of social media data.

Module 2 [8L]

Strength of Ties and Homophily

• Tie strength in social network: Strong and weak ties • Triadic closure • Bridges and local bridges • Strong triadic closure property • Closure vs structural holes as social capital • Strength of weak ties • Homophily • What is homophily? • How to measure homophily? • Mechanisms underlying homophily • Outcomes of homophily.

Module 3 [8L]

Cohesion: Network Level Metrics

• Network size • Density • Distance/diameter/average path length • Reciprocity • Triadic closure / Transitivity • Essentials of social graphs • Clustering of social-network graphs • Centrality measures • Community detection • User behavior in social networks • Information diffusion in graphs: Cascading behavior, spreading, epidemics, heterogeneous social network mining, influence maximization, outbreak detection • Graph visualization • Gephi: Exploration of a software package for visualization and analysis of graphs • Exploration of NodeXL.

Module 4 [10L]

Network Dynamics

• Popularity as a network phenomenon, • Power Laws • Rich-Get-Richer phenomena • Identifying Influencers in Social Network • Users' reactions to trolls in online communities • Fear of missing out in social network environment • Profiling users & capturing public concern: User profile-attribute based analysis, User-generated content analysis. • Assessing public opinion in social network.

Text Books and/or Reference Materials

1. Lee, I. (2017) Social Media Analytics for Enterprises: Typology, Methods and Processes, *Business Horizons*, 61(2), 199-210, retrieved from https://www.sciencedirect.com/science/article/pii/S000768131730157X

2. Libert, K. (2016), Your Network Structure Matters More than its Size, *Harvard Business Review*, retrieved from https://hbr.org/2016/02/your-networks-structure-matters- more-than-its-size

3. Sun, Q., & Shen, C. (2021). Who would respond to A troll? A social network analysis of reactions to trolls in online communities. *Computers in Human Behavior*, *121*, 106786.

4. Fioravanti, G., Casale, S., Benucci, S. B., Prostamo, A., Falone, A., Ricca, V., & Rotella, F. (2021). Fear of Missing Out and Social networking sites use and abuse: A Meta-analysis. *Computers in Human Behavior*, 106839.

5. Hu, H. H., Wang, L., Jiang, L., & Yang, W. (2019). Strong ties versus weak ties in word-of-mouth marketing. *BRQ Business Research Quarterly*, *22*(4), 245-256.

6. Easley, D., & Kleinberg, J. (2010). Networks, crowds, and markets: Reasoning about a highly connected world. New York: Cambridge University Press.

Course Name: Introduction to Philosophical Thoughts
Course Code: OECCS801B
Semester: 8
Contact Hours: L-T-P: 3-0-
0 Credits: 3

Module 1 [8L]

Nature of Indian Philosophy : Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanishadic views : Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta,Rna

Module 2 [8L]

Carvaka school : its epistemology, metaphysics and ethics. Mukti; Jainism : Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada ; pramanas, ahimsa, bondage and liberation

Module 3 [10L]

Buddhism : theory of pramanas, theory of dependent origination, the four noble truths; doctrine of momentariness; theory of no soul. The interpretation of these theories in schools of Buddhism : Vaibhasika, Sautrantrika, Yogacara, Madhyamika

Module 4 [8L]

Nyaya : theory of Pramanas; the individual self and its liberation ; the idea of God and proofs for His existence.

Text Books and/or Reference Materials

1. M. Hiriyanna : Outlines of Indian Philosophy.
2. C.D.Sharma : A Critical Survey of Indian Philosophy.
3. S.N.Das Gupta : A History of Indian Philosophy Vol – I to V.
4. S.Radhakrishnan : Indian Philosophy Vol – I & II.
5. T.R.V.Murti : Central Philosophy of Buddhism.
6. J.N.Mahanty : Reason and Tradition of Indian Thought.
7. R.D.Ranade : A Constructive Survey of Upanishadic Philosophy.
8. P.T.Raju : Structural Depths of Indian Thought.
9. K.C.Bhattacharya : Studies in Philosophy Vol – 1.
10. Datta and Chatterjee : Introduction of Indian Philosophy.

Course Name: Cyber Law, IPR and Ethics
Course Code: OECCS802A
Semester: 8
Contact Hours: L-T-P: 3-0-
0 Credits: 3
Prerequisites: Fundamentals of Computer, Computer Network

Module 1 [5L]

Introduction to Cyber Law

Evolution of computer technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

Module 2 [10L]

Information Technology Act

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

Introduction to cybercrime. Forgery, Hacking, Software Piracy, Computer Network intrusion. Category of Cybercrime: passive attack, Active attacks, cyberstalking. Tools and Methods used in Cyber crime: Proxy servers, random checking, Trojan Horses and Backdoors; DOS & DDOS attacks;

Phishing & Identity Theft: Phising methods, ID Theft; Online identity method

Module 3 [10L]

Intellectual Property Rights

Introduction and the need for intellectual property right (IPR), Kinds of Intellectual Property Rights in Internet Era: Patent, Copyright, Trade Mark,
Cyber Squatting, Reverse Hijacking, Copyright in the Digital Medium, Domain Names and Copyright disputes , Electronic Data Base and its Protection, Copyright in Computer Programmes, Copyright and WIPO Treaties.

Module 4 [5L]

Cyber Ethics

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

Text Books and/or Reference Material

Text Books

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.

2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, Cengage Learning India Private Limited.

3. Cyber Law & Cyber Crimes By Advocat Prashant Mali; Snow White publications, Mumbai

4. Information Technology Law and Practice by Vakul Sharma; Universal Law Publishing Co. Pvt. Ltd.

Reference Books

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

2. Cell for IPR Promotion and Management (http://cipam.gov.in/)

Course Name: Economic Policies in India Course Code: OECCS802B
Semester: 8
Contact Hours: L-T-P: 3-0-0 Credits: 3

Module 1 [9L]

Basic Structure of the Indian Economy

Concepts of Development, Underdevelopment – Basic Features of Indian Economy: Growth and Structural Changes in Indian Economy – Demographic Features – Population: Size, Growth, Composition and their Implications on Indian Economy – Concept of Demographic Dividend – Occupational Distribution of Population in India – Population Policy of India.

Module 2 [9L]

National Income, Poverty and Unemployment

Estimation of National Income – Trends and Composition of National Income in India – Income Inequalities in India: Magnitude, Causes, Consequences and Remedial Measures – Poverty in India: Concept, Types, Causes and Consequences – Unemployment in India: Concept, Types, Trends, Causes and Consequences – Poverty Alleviation and Employment Generation Programmes in India.

Module 3 [8L]

Planning and Public Policy

Five Year Plans: Concept and Objectives – Review of Five Year Plans – NITI Aayog – Economic Reforms: Liberalization, Privatization and Globalization – Impact of WTO on Indian Economy.

Module 4 [10L]

Agricultural and Industrial Sectors

Importance and Role of Agriculture in Indian Economy – Trends in Agricultural Production and Productivity – Land Reforms – Green Revolution – Agricultural Finance – Agricultural Marketing – Agricultural Pricing – Food Security in India. Structure, Growth, Importance and Problems of Indian Industry – Large, Medium and Small Scale Industries: Role and Problems – Industrial Policies of 1948, 1956 and 1991– FEMA and Competition Commission of India – Disinvestment Policy – Foreign Direct Investment.

Learning Resources:

1. Dutt Rudder and K.P.M Sunderam (2001): Indian Economy, S Chand & Co. Ltd. New Delhi.

2. Mishra S.K & V.K Puri (2001) "Indian Economy and –Its development experience", Himalaya Publishing House.

3. KapilaUma: Indian Economy: Policies and Performances, Academic Foundation

4. Bardhan, P.K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.

5. Jalan, B. (1996), India's Economic Policy- Preparing for the Twenty First Century, Viking, New Delhi.

Course Name: Parallel Computing Course Code: PECCS801A Semester: 8
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Computer Organization and Architecture

Module 1 [7L]

Introduction – Parallel Processing Environment – Pipelining and Data Parallelism, Scalability, Flynn's Taxonomy, Parallel Processing organization- Mesh, Hyper-tree, Pyramid, Butterfly, Hypercube network.

Module 2 [11L]

Parallel Algorithms – Structure, cost, Analysis; Elementary Algorithms: Broadcast, Prefix sums, All sums, Algorithms on Selection problem, Merging-Odd-even merging network, CREW Merging, N-ary searching.

Matrix Transposition, Matrix Multiplications – 2D Mesh SIMD, Hypercube SIMD, Shuffle-Exchange SIMD model; Discrete Fourier Transform, Fast Fourier Transform.

Module 3 [6L]

Linear system of equations – Gaussian Elimination, Gauss-Seidel algorithm, Jacobi algorithm; Sorting – Enumeration sort, Odd-even transposition sort, Bitonic merge Ellis's Algorithm.

Module 4 [6L]

Graph Algorithms, Spanning Tree Algorithms, Parallel Programming Languages –FORTRAN 90, OCCAM.

Text Books and/or Reference Material

1. Parallel Computing –Theory and Practice -Michael J. Quinn (McGraw Hill Inc.)

2. Design and Analysis of Parallel Algorithms- S.G. Akl (PH)

Course Outcome:

CO1: Describe and apply various techniques for getting an idea of Parallel Processing Environment
CO2: Introduction to the different Parallel Algorithms
CO3: Describe different Linear System of Equations
CO4: Introduction to Graph Algorithms and some Parallel programming Languages.

Course Name: Pattern
Recognition Course Code:
PECCS801B Semester: 8
Contact Hours: L-T-P: 3-0-0
Credits: 3
Prerequisites: Data Structure and Algorithm , Mathematics and Statistics, Artificial Intelligence & Machine Learning Fundamentals

Module 1 [7L]

Introduction - Definitions, data sets for Pattern
Recognition Different Paradigms of Pattern Recognition
Representations of Patterns and Classes
Metric and non-metric proximity measures

Module 2 [7L]

Feature extraction
Different approaches to Feature
Selection Nearest Neighbour Classifier
and variants
Efficient algorithms for nearest neighbour classification

Module 3 [11L]

Different Approaches to Prototype
Selection Bayes Classifier
Decision Trees
Linear Discriminant Function

Module 4 [11L]

Support Vector
Machines Clustering
Clustering Large datasets
Combination of Classifiers
Applications - Document Recognition

Text Books and/or Reference Material

Text Books

14. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
15. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.
16. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013
17. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer
18. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
19. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and PiercesareSecchi, Springer, 2013

Reference Books

4. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012
5. Hadoop: The Definitive Guide (2ndEdn.) by Tom White, O'Reilly, 2014
6. MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems, Donald Miner, Adam Shook, O'Reilly, 2014
7. Beginning R: The Statistical Programming Language, Mark Gardener, Wiley, 2013

Course Name: Augmented Reality and Virtual Reality
Course Code: PECCS801C
Semester: 8
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Computer Graphics

<u>Module 1 [6L]</u>

Introduction to augmented reality (AR) and virtual reality (VR)

Modern AR/VR experiences; Bird's-Eye view of hardware, software; Geometry of virtual worlds; Changing position and orientation, axis-angle representations of rotation; Viewing transformations and chaining the transformations;

<u>Module 2 [10L]</u>

Realizing vision in virtual environment

Light and optics; Lenses and optical aberrations; Human eye vs camera; Displays; Physiology of Human Vision; Implications of human vision for AR/VR; Visual perception including depth, motion, color; Visual rendering; Ray tracing and shading, rasterization; Enhancing the rendering;

<u>Module 3 [11L]</u>

Motion & interaction in virtual environment

Motion in Real and Virtual Worlds, Human vestibular system; Physics in the virtual world; Tracking 2D and 3D orientation; Tracking position and attached bodies; Environment scanning; Interaction, locomotion, manipulation, additional interactions;

Module 4 [10L]

Extending to other senses in virtual environment

Physics of audio; Physiology of human hearing; Auditory perception and rending; Virtualizing other human senses and receptors; Evaluation of AR/VR experience in terms of training, recommendations, limitations; Application of AR/VR in Internet-of-Things, Android app development.

Text Books and/or Reference Books

1. Steven LaValle, "Virtual reality." (2016), Cambridge University Press

2. Woodrow Barfield, ed. Fundamentals of wearable computers and augmented reality. CRC press, 2015.

3. Kelly S. Hale, and Kay M. Stanney, eds. Handbook of virtual environments: Design, implementation, and applications. CRC Press, 2015.

4. Dieter Schmalstieg, and Tobias Hollerer. Augmented reality: principles and practice. Addison- Wesley Professional, 2016.

5. William R Sherman, and Alan B. Craig. "Understanding virtual reality—Interface, application, and design." (2003).

Course Name: Data Encryption and Compression Course Code: PECCS801D
Semester: 8
Contact Hours: L-T-P: 3-0-0 Credits: 3
Prerequisites: Computer Networks, Cryptography and Network Security

Module 1 [8L]

Data Compression

Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques, Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW.

Module 2 [6L]

Audio Compression

High quality digital audio, frequency and temporal masking, lossy sound compression, µ-law and A-law companding, and MP3 audio standard

Module 3 [8L]

Image Compression

PCM, DPCM JPEG, JPEG –LS , and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG -2 H-264 encoder and decoder

Module 4 [14L]

Data Security

Security goals, cryptography, stenography cryptographic attacks, services and mechanics. Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm, Malware, Intruders, Intrusion detection system, firewall design, antivirus, techniques, digital Immune systems, biometric authentication, and ethical hacking.

Text Books and/or Reference Material

Text Books

1. Data Compression and Cryptography, J. S. Katre, Pravin Goyal, TechKnowledge Publications

2. Data Compression, The Complete Reference, 3rd Ed - David Salomon, Springer-Verlag London

Reference Books

1. Data Compression: Methods and Theory, Principles of Computer Science Series, James A. Storer, W.H. Freeman & Company; Later Printing edition

Course Outcome:

CO1: Describe and apply various techniques for text compression and also evaluate performance of the coding techniques.
CO2: Explain digital audio, companding, perceptual audio coding and MPEG audio compression standard
CO3: Describe different lossless and lossy image and video compression techniques and 5 standards
CO4: Differentiate between symmetric and asymmetric cryptography and also describe different symmetric cryptographic techniques and standards