Haldia Institute of Technology

An Autonomous Institute (An Institution of ICARE)

NAAC Accredited Grade 'A' Institute

(Approved by All India Council for Technical Education (AICTE) and Affiliated to MAKAUT)

Curriculum for the

B.Tech in Computer Science and Engineering

(NBA Tier-I Accredited Department)

(For Academic year 2024-2025)

Syllabus for B. Tech in Computer Science and Engineering

For Academic Year 2024-2025

Institutional Vision & Mission

VISION

To achieve Centre of Excellence in the field of Science, Technology and Management Education for creating dynamic human resources of global standards with capabilities of accepting new challenges.

MISSION

- To impart quality and value-based education to raise satisfaction level of all stake-holders.
- To create competent, creative professionals, and great entrepreneurs who can work as individual or in group in multi-cultural global environments.
- To prepare citizens who would grow to be competent enough to contribute significantly with personal integrity and civic responsibility for the betterment of mankind throughout their careers and profession.

Syllabus for B. Tech in Computer Science and Engineering

For Academic Year 2024-2025

Department of Computer Science and Engineering

VISION

To be a centre of excellence in Computer Science and Engineering by nurturing innovation, multidisciplinary learning, research, and ethical values, producing globally competent professionals capable of addressing technological and societal challenges through sustainable solutions.

MISSION

- To provide a strong foundation in Computer Science and Engineering through outcome-based, learner-centric education, integrating experiential learning and modern computing practices to cultivate analytical thinking, innovation, and problem-solving abilities.

- To nurture technically proficient and ethically responsible professionals by providing exposure to emerging technologies, industry-oriented learning, effective communication, teamwork, leadership, and entrepreneurial skills for successful careers and lifelong learning.

- To encourage multidisciplinary research, innovation, and collaborative learning to develop sustainable, secure, and socially responsible computing solutions that address contemporary regional, national, and global challenges.

Syllabus for B. Tech in Computer Science and Engineering

For Academic Year 2024-2025

PROGRAM OUTCOME (POs):

Engineering Graduates will be able to:

PO-1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO-1: To provide students with a strong foundation in applied science and Computer Science & Engineering fundamentals necessary to analyze the requirements of the software, understand the technical specifications, design and create innovative computing products and solutions for real life problems.

PEO-2: To provide exposure to emerging technologies, adequate training and opportunities to work as teams on multidisciplinary projects with effective communication skills and leadership qualities.

PEO-3: To prepare the students for a successful professional career as engineer, scientist, teacher, technocrat, administrator or an entrepreneur and work with values & social concern bridging the digital divide and meeting the requirements of Indian and multinational companies.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO-1: Demonstration of Basic Knowledge: Ability to understand the principles & working of computer systems; demonstrate, analyze, apply management principles, mathematical foundations in the development of computational solutions.

PSO-2: Problem Solving Skills: Ability to design and develop computer programs and computer-based systems of moderate complexity in the areas pertaining to database, networking, web-design, artificial intelligence and information security.

PSO-3: Professional Skills: Ability to apply standard practices and methods in software project management and software development using suitable programming environments to deliver quality product for the industry.

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Second Year - Third Semester

Semester III							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Course	ESC-CSE 301	Digital Logic Design	3	0	0	3
2	Professional Core Course	PCC-CSE 301	Data Structure & Algorithms	3	0	0	3
3	Professional Core Course	PCC-CSE 302	Computer Organization & Architecture	3	0	0	3
4	Basic Science course	BSC-CSE 301	Mathematics-III (Probability and Statistics)	3	0	0	3
5	Mandatory Course	MC-CSE 301	Environmental Sciences	1	0	0	0
6	Humanities & Social Sciences including Management course	HSMC-CSE 301	Economics for Engineers (Humanities-II)	3	0	0	3
Practical							
7	Engineering Science Course	ESC-CSE 391	Digital Logic Design Lab	0	0	4	2
8	Professional Core Course	PCC-CSE 391	Data Structure & Algorithms Lab	0	0	4	2
9	Professional Core Course	PCC-CSE 392	Computer Organization & Architecture Lab	0	0	4	2
10	Professional Core Course	PCC-CSE 393	IT Workshop-I (Programming with Python)	0	0	4	2
Total credit of the Semester							**23**

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Second Year - Fourth Semester

Semester IV							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Course	PCC-CSE 401	Database Management System	3	0	0	3
2	Professional Core Course	PCC-CSE 402	Object Oriented Programming	3	0	0	3
3	Professional Core Course	PCC-CSE 403	Machine Learning	3	0	0	3
4	Professional Core Course	PCC-CSE 404	Discrete Mathematics	3	0	1	4
3	Professional Core Course	PCC-CSE 405	Formal Language & Automata Theory	3	0	0	3
6	Humanities & Social Sciences including Management course	HSMC-CSE 401	Introduction to Industrial Management (Humanities-III)	3	0	0	3
Practical							
7	Engineering Science Course	PCC-CSE 491	Database Management System lab	0	0	4	2
8	Professional Core Course	PCC-CSE 492	Object Oriented Programming Lab	0	0	4	2
9	Professional Core Course	PCC-CSE 493	Machine Learning Lab	0	0	4	2
Total credit of the Semester							**25**

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Third Year - Fifth Semester

Semester V							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Course	ESC-CSE 501	Compiler design	3	0	0	3
2	Professional Core Course	PCC-CSE 501	Operating Systems	3	0	0	3
3	Professional Core Course	PCC-CSE 502	Design & Analysis of Algorithms	3	0	0	3
4	Professional Elective courses	PEC-CSE 501 A/B/C	(Elective-I) Artificial Intelligence/ Human Computer Interaction/ Computer Graphics	3	0	0	3
5	Open Elective courses	OEC-CSE 501 A/B/C	(Open Elective-I) Operations Research/ Multimedia Systems/ Introduction to Philosophical Thoughts	3	0	0	3
6	Humanities & Social Sciences including Management course	HSMC-CSE 501	Project Management and Entrepreneurship (Humanities-IV)	2	1	0	3
Practical							
7	Professional Core Course	PCC-CSE 591	Operating Systems Lab	0	0	4	2
8	Professional Core Course	PCC-CSE 592	Design & Analysis of Algorithms Lab	0	0	4	2
9	Professional Core Course	PCC-CSE 593	IT Workshop-II (Web Programming)	0	0	4	2
Total credit of the Semester							**24**

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Third Year - Sixth Semester

Semester VI							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Course	PCC-CSE 601	Cloud Computing	3	0	0	3
2	Professional Core Course	PCC-CSE 602	Computer Networks	3	0	0	3
3	Professional Core Course	PCC-CSE 603	Introduction to Cyber Security & Blockchain Technology	3	0	0	3
4	Professional Elective courses	PEC-CSE 601 A/ B/C	(Elective-II) Advanced Algorithms/ Distributed Systems/ Image Processing	3	0	0	3
5	Professional Elective courses	PEC-CSE 602 A/B/C	(Elective-III) Parallel and Distributed Algorithms/ Data Mining/ Pattern Recognition	3	0	0	3
6	Open Elective courses	OEC-CSE 601 A/B/C	(Open Elective-II) Numerical Methods/ Human Resource Development and Organizational Behavior/ Soft Skill & Interpersonal Communication	3	0	0	3
Practical							
7	Professional Core Course	PCC-CSE 691	Cloud computing Lab	0	0	4	2
8	Professional Core Course	PCC-CSE 692	Computer Networks Lab	0	0	4	2
Total credit of the Semester							**22**

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Fourth Year - Seventh Semester

Semester VII							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Elective courses	PEC-CSE 701 A/B/C/D	(Elective-IV) Quantum Computing/ Software Engineering /Neural Networks and Deep Learning/ Soft Computing	3	0	0	3
2	Professional Elective courses	PEC-CSE 702 A/B/C/D	(Elective-V) Signals and Networks/ Cryptography & Network Security/ Speech and Natural Language Processing/ Internet of Things	3	0	0	3
3	Industrial Internship/ Training	TR-CSE 771	Industry Internship	0	0	0	3
4	Project	PROJ- CSE 781	Project-I	0	0	12	6
Total credit of the Semester							**15**

Curriculum Structure for B. Tech in Computer Science and Engineering
For Academic Year 2024-2025

Fourth Year - Eighth Semester

Semester VIII							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Open Elective courses	OEC-CSE 801 A/B/C/D	(Open Elective-III) Big Data Analysis/ Cyber Law and Ethics/ Mobile Computing/ Ad-hoc and Sensor Network	3	0	0	3
2	Industrial Internship/ Training	TR-CSE 871	Industry Internship	0	0	0	3
3	Project	PROJ- CSE 881	Project-II	0	0	12	6
Total credit of the Semester							**12**

Detailed Syllabus for B. Tech in Computer Science & Engineering
For Academic Year 2024-2025

Second Year - Third Semester

Digital Logic Design
Code: ESC-CSE 301
Contact: 3L
Theory: 3 hrs. /Week
Credit point: 3

Course Objective:	
1.	Familiar with the digital signal, positive and negative logic, Boolean algebra, logic gates, logical variables, and number systems.
2.	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
3.	To prepare students to perform the analysis and design of various digital electronic circuits

Pre-Requisite:	
1.	Boolean algebra
2.	Basic understanding of diode, transistor operation.

Unit	Content	Hrs.
1.	Binary Number System & Boolean Algebra; BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Basic logic gates, Universality of NAND, NOR gates, AND-OR-Invert gates, Positive and Negative Logic; Boolean Algebra axioms and basic theorems; Standard and canonical representations of logic functions, Conversion between SOP and POS; Simplification of logic functions, Karnaugh Map, Don't Care Conditions	9
2.	Combinational logic circuits: Adder and substructures, Multiplexers, de multiplexers, Encoders, decoders, code convertors, magnitude comparators, parity generators and checkers. Binary Adder: Serial and Parallel Adders. CPA, CLA, CSA.	11
3.	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, Design of Mod N Counter	10
4.	A/D and D/A conversion techniques – Basic concepts (D/A: R-2-R only, A/D: successive approximation) Logic families- TTL, ECL, MOS and CMOS – basic concepts.	6

Text book and Reference books:

1. Morries Mano, Digital Logic and computer Design, PHI, 2017
2. R.P.Jain, Modern Digital Electronics, 4/e, McGraw Hill,2008.
3. Leach & Malvino, Digital Principles & Application, 5/e, McGraw Hill
4. Floyed & Jain, Digital Fundamentals, Pearson.
5. S. Salivahanan, S. Arivazhgan, Digital Circuits and Design, 5th edition, Oxford University Press, 2018.
6. A. Anand Kumar. Fundamentals of digital electronics, 4/e, PHI, 18 Jul 2016

Course Outcome:	
On completion of the course students will be able to	
ESC-CSE 301.1	Explain number systems, basic logic gates, Boolean algebra and define characteristics of logic families.
ESC-CSE 301.2	Apply Boolean laws and K-map to simplify the Boolean Expression.
ESC-CSE 301.3	Analyse and design various combinational and sequential Circuits.
ESC-CSE 301.4	Understand various types of components-ADC and DAC, the different logic families involved in the digital system.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	1	1	1	1	1	-	2	2	1	2
CO2	2	3	3	3	2	-	1	-	2	2	2	2	3	2	1
CO3	3	2	2	3	2	-	-	-	2	2	1	2	3	1	2
CO4	2	3	2	3	2	-	1	1	3	2	2	3	3	2	1
AVG.	2.25	2.25	2.00	2.75	1.75	1	1	1	2.00	1.75	1.67	2.25	2.75	1.5	1.5

Data Structure & Algorithm
Code: PCC-CSE 301
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To Understand Abstract Data Types (ADTs)
2.	To Master Linear and Nonlinear Data Structures
3.	To Apply Sorting and Searching Algorithms
4.	To Develop Practical Problem-Solving Skills

Pre-Requisite:	
1.	CS 201 (Basic Computation and Principles of C)
2.	M101 & M201 (Mathematics), basics of set theory

Unit	Content	Hrs.
1.	Introduction to Algorithms and Complexity, **Basic Terminologies:** Elementary data organizations, Recursion. **Data Structure Operations:** Insertion, deletion, traversal. Analysis of an Algorithm: Asymptotic notations (Big O, Omega, Theta). **Time-Space Trade-Off:** Understanding trade-offs in algorithm design. **Searching Techniques:** Linear Search, Binary Search and their complexity analysis.	8
2.	**ADT Stack and Its Operations:** Algorithms and complexity analysis. **Applications of Stacks:** Expression conversion and evaluation. **ADT Queue:** Types of Queue - Simple Queue, Circular Queue, Priority Queue; operations and algorithms for each type.	6
3.	**Singly Linked Lists:** Representation in memory, algorithms for traversal, searching, insertion, and deletion. **Linked Representation:** Stacks and queues using linked lists.	6

	Doubly Linked Lists: Operations and algorithmic analysis. **Circular Linked Lists:** All operations, algorithms, and complexity analysis.	
4.	**Basic Tree Terminologies:** Definitions and properties. **Types of Trees:** Binary Tree, Binary Search Tree, AVL Tree; tree operations and algorithms with complexity analysis. **Applications of Binary Trees:** Overview of applications in databases and decision making. Graph Terminologies: Basic definitions and representations. Graph Traversal Algorithms: BFS, DFS and their complexity analysis. Shortest Path Algorithms: Introduction to Dijkstra's algorithm.	8
5.	**Sorting Algorithms:** Selection Sort, Bubble Sort, Quick Sort, Merge Sort. **Performance and Comparison:** Analysis of sorting methods. **Hashing Techniques:** Basics of hash tables.	8

Text book and Reference books:

1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, SartajSahni, Susan Andersonfreed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Data Structures Using C" by ReemaThareja.
6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
8. "Data Structure through C" by Yaswant Kanetkar, BPB Publications.

Course Outcomes:	
PCC-CSE 301.1	Demonstrate proficiency in foundational data structures and algorithms to solve computational problems effectively.
PCC-CSE 301.2	Apply algorithmic thinking and asymptotic analysis to design and evaluate efficient algorithms for diverse computational tasks and data manipulation operations.
PCC-CSE 301.3	Analyse algorithm performance using time-space complexity analysis and optimize algorithms for improved efficiency and scalability in various applications.
PCC-CSE 301.4	Demonstrate the ability to apply various data structures and algorithms effectively to solve practical problems encountered in different applications and domains.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	1	1	2	3	3	2
CO2	3	3	2	2	3	1	1	1	2	1	1	2	3	3	2
CO3	3	3	3	3	3	1	1	1	2	2	1	3	3	3	2
CO4	3	3	3	2	3	2	2	1	3	2	2	3	3	3	3
AVG.	3.00	3.00	2.50	2.25	2.75	1.25	1.25	1.00	2.00	1.50	1.25	2.50	3	3	2.25

Computer Organization & Architecture
Code: PCC-CSE 302
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To conceptualize the basics of organizational and architectural issues of a digital computer.
2.	To analyze performance issues in processor and memory design of a digital computer.
3.	To understand various data transfer techniques in digital computer.
4.	To analyze processor performance improvement using instruction level parallelism.

Pre-Requisite:	
1	Number systems
2	Basic programming skills
3	Basics of Digital Electronics

Unit	Content	Hrs.
1.	Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.	8
2.	Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation. Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.	8
3.	Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control. Design of control unit. Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer. Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.	10
4.	Reduced Instruction Set Computer: CISC Characteristics, RISC Characteristics. Flynn's Classification of computers. Pipelining: Introduction, Definition, Space time diagram, Clock period. Performance measurement: Speed-up, Efficiency and Throughput, Example; Classification of pipelined processors. Design of arithmetic pipelines: Floating point adder pipeline, Multiplier pipeline. Issues in pipeline design: Pipeline hazards. Multiple issue processors: Super-pipelining, Super-scalar and VLIW. Vector processing: Introduction, Characteristics. SIMD array processor: Introduction, Classification. Multiprocessor: Introduction, Classification.	10

Text book and Reference books:

1. Computer System Architecture – M. Moris Mano, Third Edition, Pearson/PHI.
2. Computer Organization – Car Hamacher, Zvonks Vranesic, Safea Zaky, Vth Edition, McGraw Hill.
3. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
4. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.
5. Computer Architecture and Organization, 3rd Edition by John P. Hayes, WCB/McGrawHill
6. Computer Architecture and Parallel Processing by Hwang and Briggs (Mc-Graw Hill).
7. Computer Organization and Architecture: Designing for Performance, 10th Edition by William Stallings, Pearson Education.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 302.1	Understand the basics of instructions sets and their impact on processor design
PCC-CSE 302.2	Demonstrate an understanding of the design of the functional units of a digital computer system.
PCC-CSE 302.3	Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory.
PCC-CSE 302.4	Design a pipeline for consistent execution of instructions with minimum hazards.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	3	-	2	-	-	-	-	2	2	3	2
CO2	3	3	-	3	2	-	-	-	-	-	-	-	3	3	2
CO3	3	3	-	3	2	-	2	-	-	-	-	-	3	3	2
CO4	3	2	3	2	-	-	2	-	-	-	-	-	3	2	1
AVG.	**3.00**	**2.75**	**3.00**	**2.67**	**2.33**	**-**	**2.00**	**-**	**-**	**-**	**-**	**2.00**	**2.75**	**2.75**	**1.75**

Mathematics-III (Probability & Statistics)
Course: BSC-CSE 301
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Explain and apply the basic principles of probability and statistics.
2.	Understand and use various probability distributions.
3.	Perform hypothesis testing and construct confidence intervals.
4.	Analyze relationships between variables using regression and correlation.

Pre-Requisite:	
1.	Basics of Set Theory, Graph Theory
2.	Principle of Mathematical Induction, Proof by Contradiction

Unit	Content	Hrs.
1.	Probability spaces, Axiomatic definition of Probability, Conditional probability, Independent events, Bayes theorem (Proof not required). Probability Distributions: Discrete and continuous and their properties, Distribution functions and densities, Expectation and Variance, Binomial, Poisson, Uniform, Exponential, Normal distributions. Binomial and Poisson approximation to Normal distribution. t, χ^2 and F-distribution (Definition only). Transformation of random variables. Central Limit Theorem, Law of large numbers (statement only) and their applications. Tchebychev inequalities (statement only) and its application.	12
2.	Bivariate Distributions: Two-dimensional random variable, Distribution function and its properties: Discrete and continuous, Marginal distribution, Conditional distribution, Mathematical expectation of bi-variate distribution, Conditional expectation, Correlation and regression - Rank correlation coefficient, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	10
3.	Random sampling, Parameter, Statistic and its Sampling distribution. Standard error of statistic. Sampling distribution of sample mean and variance in random	8

	sampling from a normal distribution (statement only) and related problems. Estimation of parameters: Unbiased and consistent estimators. Point estimation. Interval estimation. Maximum likelihood estimation of parameters (Binomial, Poisson and Normal). Confidence intervals and related problems.	
4.	Simple and Composite hypothesis. Critical region. Level of significance. Type I and Type II errors. One sample and two sample tests for means and proportions. χ 2 - test for goodness of fit.	6

Text book and Reference books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Kapoor, V. K and Gupta, S.C.: Fundamental of Mathematical Statistics, Sultan Chand and Sons.
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000. (vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
7. Spiegel M R., Schiller J.J. and Srinivasan R.A. : Probability and Statistics (Schaum's Outline Series), TMH.

Course Outcomes:	
On completion of the course students will be able to	
BSC-CSE 301.1	Recite concept of permutation and combination, concept of descriptive statistics.
BSC-CSE 301.2	Discuss the concept probability distribution, statistical inference and hypothesis testing.
BSC-CSE 301.3	Demonstrate computational modelling of statistics and applies techniques to solve problem of chances and data.
BSC-CSE 301.4	Illustrate physical scenario and classify them to recognize the best fit physical and logical models.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	2	1	-	2	3	3	2
CO2	3	3	3	3	2	-	-	-	2	2	-	3	3	3	2
CO3	3	3	3	3	3	2	3	-	3	-	-	3	3	3	3
CO4	2	3	3	3	3	-	-	2	3	2	3	2	3	3	3
AVG.	2.75	2.75	2.75	3.00	2.67	2.00	3.00	2.00	2.50	1.67	3.00	2.50	3.00	3.00	2.50

Environmental Sciences
Code: MC-CSE 301
Contacts: 1L
Theory: 1hrs. /week

Course Objective:	
1.	To understand the natural environment and its relationship with human activities.
2.	To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3.	To solve problem related to Air, Water, Noise and Land pollution.
4.	To understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	**Environment and Ecosystem:** Environment: Basic concepts of Environment; Biosphere; Society, Environment & their interrelationship; Nature and scope of Environmental Science and Engineering; Sustainable Development Ecosystem: Components of ecosystem; Ecosystem management; Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (Special reference to Sundarban); Food chain; Food web; Ecological Pyramid Biodiversity: Types, Importance, Endemic species, Biodiversity Hot-spot; Threats to biodiversity; Conservation of biodiversity Biogeochemical Cycle: Definition, Significance, flow chart of different cycles with only elementary reaction (Oxygen, Carbon, Nitrogen, Phosphate, Sulphur etc.)	5
2.	**Air Pollution, Water Pollution and Control:** Air Pollution and Control: Atmospheric composition; Climate, Weather; Definition of pollutants and contaminants, Primary and secondary pollutants, sources and effects of pollutants; Greenhouse effect, Depletion of ozone layer, Acid rain, Control measures Water Pollution and Control: Hydrosphere, Hydrological cycle and Natural water; Sources and effects of water pollutants Water Treatment System: Physical Unit Processes; Chemical Unit Processes; Biological Unit Processes.	8
3.	**Land and Noise Pollution:** Land Pollution: Lithosphere; Pollutants (Municipal, Industrial, Commercial, Agricultural, Hazardous Solid Wastes); Origin and effects; Collection and disposal of solid waste, Recovery and conversion methods Noise Pollution: Sources, Effects, Standards and Control.	5
4.	**Environmental Management:** Environmental Impact Assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty / Agreement / Protocol Awareness Activities: Small group meetings about waste management, Promotion of recycle use, Cleanliness drive, Avoiding electricity waste, Plantation, Slogan making event, Poster making event.	6

Textbooks:
1. Principles of Environmental Engineering, Gilbert Masters
2. Introduction to Environmental Biotechnology, Milton Wainwright
3. Environmental Biotechnology, Pradipta Kumar Mohapatra

4. Environmental Science, S.C. Santra
5. Ecology and Environment, PD Sharma PD, Rastogi Publications, Delhi

Web Reference:

1. **https://onlinecourses.nptel.ac.in/noc24_ge19/preview**
2. **https://onlinecourses.nptel.ac.in/noc23_hs155/preview**
3. https://onlinecourses.nptel.ac.in/noc21_hs83/preview
4. https://onlinecourses.nptel.ac.in/noc20_ge16/preview

Course Outcomes:	
On completion of the course students will be able to	
MC-CSE 301.1	Understand the concept of environment and elaborate the organization of ecosystem, its components.
MC-CSE 301.2	Identify, understand and distinguish the different environmental pollution associated with environmental degradation.
MC-CSE 301.3	Design, formulate and develop different control mechanisms, devices to minimize the environmental pollution.
MC-CSE 301.4	Create and promote various environmental awareness programs in the society.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	2	3	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	2	3	-	-	-	-	-	-	-	-
CO3	2	2	2	2	-	2	3	-	-	-	-	-	1	1	1
CO4	1	-	-	-	-	3	3	-	2	2	-	3	-	-	-
AVG.	1.5	1.67	1.67	2	-	2.25	3	-	2	2	-	3	1	1	1

Economics for Engineers (Humanities-II)
Code: HSMC-CSE 301
Contacts: 3L
Theory: 3 hrs./ Week
Credit Points: 3

Course Objective:	
1.	Understand basic economic concepts and their relevance to engineering decision-making.
2.	Apply economic principles to analyse engineering projects and assess their feasibility.
3.	Develop skills in cost estimation, project evaluation, and risk analysis.
4.	Gain insights into the economic implications of engineering decisions on society and the environment.

Pre-Requisite:	
1.	Analytical and mathematical skills

Unit	Content	Hrs.
1.	**Introduction to Engineering Economy:** Origin of Engineering Economy, Principles of Engineering Economy, Role of Engineers in Decision Making	4
2.	**Time Value of Money :** .Introduction to Time Value of Money, Simple Interest, Compound Interest, Nominal Interest rate, Effective Interest	7

	rate, Continuous Compounding, Economic Equivalence, Development of Interest Formulas, The Five Types of Cash flows, Single Cash flow Formulas, Uneven Payment Series, Equal Payment Series	
3.	**Methods of comparison of alternatives:** NPV, Profitability Index or Benefit Cost Ratio, Payback Period Method, Equivalent Worth Methods, Present Worth Method, Future Worth Method, Annual Worth Method, Rate of Return Methods (IRR and ARR)	7
4.	**Engineering Costs & Estimation:** Elements of cost (Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs) and cost estimation models (Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve), Concept of Revenue, Break even analysis, Cost sheet.	6
5.	**Inflation And Price Change:** Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	6

Text book and Reference books:

1. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
2. R. Paneer Seelvan: Engineering Economics, PHI
3. Sullivan and Wicks: Engineering Economy, Pearson
4. John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley
5. James L. Riggs, David D. Bedworth, Sabah U. Randhawa: Economics for Engineers 4e,Tata Mc Graw - Hill

Course Outcome:	
On completion of the course students will be able to	
HSMC-CSE 301.1	Students will recall and explain fundamental concepts of engineering economics.
HSMC-CSE 301.2	Students will analyze project cost structures, estimate costs using appropriate methods, and evaluate cost-effectiveness of the engineering projects using NPV, IRR, BCR etc.
HSMC-CSE 301.3	Students will integrate economic sustainability considerations into engineering design and decision-making processes by assessing project risk through sensitivity analysis.
HSMC-CSE 301.4	Students will engage in critical analysis of economic challenges, synthesizing information to devise innovative solutions for engineering problems, which will be grounded in ethical considerations, addressing both economic constraints and societal needs.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	0	0	0	0	0	3	3	3	2	1
CO2	2	2	2	2	1	0	0	0	0	0	3	3	3	2	1
CO3	1	3	3	3	3	0	0	0	0	0	3	3	3	2	1
CO4	1	3	3	3	3	0	0	0	0	0	3	3	3	2	1
AVG.	**1.5**	**2.5**	**2.5**	**2.5**	**2.0**	**0**	**0**	**0**	**0**	**0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**

Digital Logic Design Lab
Code: ESC-CSE 391
Contacts: 4P
Practical: 4 hrs./ Week
Credit points: 2

Course Objective:	
1.	To learn Boolean Algebra and Understand the various logic gates.
2.	To design and implement various combinational circuit, synchronous sequential, asynchronous sequential circuits.
3.	To be familiar with basic combinational and sequential components used in the typical data path designs.

Pre-Requisite:	
1	Boolean Algebra,
2	Basic understanding of diode, transistor operation.

Laboratory Experiments:	
1	Implement various logic gates, half adder, full adder using universal logic gates.
2	Design a Full Adder using basic gates and verify its output, Design a Full Subtractor circuit using basic gates and verify its output.
3	Design code converter circuit. (BCD to Excess-3 and vice versa, Binary to Gray and vice versa)
4	Design 2 to 4 Decoder, 4 to 2 Encoder.
5	Design 4:1 Multiplexer, 1:4 Demux.
6	Design Magnitude comparator.
7	Design Flip-flops: SR, D, JK, T, Master slave JK Flipflops.
8	Design Shift Register.
9	Design Asynchronous Up/Down counter.
10	Design Synchronous Up/Down counter.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

1. Morries Mano, Digital Logic and computer Design, PHI, 2017
2. R.P.Jain, Modern Digital Electronics, 4/e, McGraw Hill,2008.
3. Leach & Malvino, Digital Principles & Application, 5/e, McGraw Hill
4. Floyed & Jain, Digital Fundamentals, Pearson.
5. S. Salivahanan, S. Arivazhgan, Digital Circuits and Design, 5th edition, Oxford University Press, 2018.
6. A. Anand Kumar. Fundamentals of digital electronics, 4/e, PHI, 18 Jul 2016

Course Outcome:	
On completion of the course students will be able to	
ESC-CSE 391.1	Define different types of logic gates, identify their ICs and also verify their truth table.
ESC-CSE 391.2	Interpret realization of Boolean expression in SOP and POS form and design it using logic gates.
ESC-CSE 391.3	Apply Boolean simplification techniques to design a combinational hardware circuit.
ESC-CSE 391.4	Design synchronous sequential circuits using basic flip-flops, counters.

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	1	2	1	1	1	2	2	1	2
CO2	2	2	2	2	2	-	2	-	2	2	2	2	3	2	1
CO3	2	2	2	2	2	-	2	-	2	2	2	2	3	1	2
CO4	2	2	3	3	2	-	2	-	2	2	2	2	3	2	1
AVG.	**1.75**	**2.00**	**2.00**	**2.25**	**1.75**	**1**	**1.75**	**2**	**1.75**	**1.75**	**1.75**	**2.00**	**2.75**	**1.5**	**1.5**

Data Structure & Algorithm Lab
Code: PCC-CSE 391
Contacts: 4P
Practical: 4 hrs./ Week
Credit Points: 2

Objectives:	
1.	Master in Implementation of Linear Data Structures
2.	Apply Algorithmic Concepts to Solve Practical Problems
3.	Explore and Implement Non-Linear Data Structures
4.	Practice Application of Sorting and Searching Algorithms

Pre-Requisite:	
1.	Pre-requisites as in PCC-CS301 (Assumed foundational knowledge in programming and basic data structures)

Laboratory Experiments:	
Linear Data Structures	
1.	Implementation of Array Operations: Perform operations such as insertion, deletion, and traversal on arrays.
2.	Stacks and Queues: implement operations for stacks (push, pop) and queues (enqueue, dequeue). Implement Circular Queue operations: Adding and deleting elements.
3.	Expression Evaluation using Multiple Stacks and Queues
4.	Implementation of Linked Lists: Implement operations like insertion, deletion, and inversion on linked lists. Implement stacks and queues using linked lists.
5.	Polynomial Operations: Perform polynomial addition and multiplication.
Non-Linear Data Structures	
6.	Recursive and Non-recursive Traversal of Trees: Implement recursive and non-recursive traversal algorithms for trees.
7.	Threaded Binary Tree Traversal: Implement threaded binary tree traversal algorithms.
8.	AVL Tree Implementation: Implement AVL tree operations for balanced binary search trees.
9.	Hash Tables Implementation: Implement hash tables and perform operations like searching, inserting, and deleting.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

1. "Data Structures Using C" by ReemaThareja.
2. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.

3. “Data Structure Lab Experiment With C”, by Girish Rao Salanke, Medtech.

Course Outcomes:	
PCC-CSE 391.1	Understand and analyze fundamental concepts of data structures, including algorithm efficiency and performance evaluation using asymptotic notations.
PCC-CSE 391.2	Implement and apply various linear data structures, performing key operations and understanding their applications in computational problems.
PCC-CSE 391.3	Develop and utilize non-linear data structures, including different traversal methods, and comprehend their practical applications in software development.
PCC-CSE 391.4	Evaluate and implement advanced data structures, analyze key algorithms for efficiency, and appreciate their significance in solving complex computational challenges.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	1	1	3	3	2	2
CO2	3	3	3	2	3	1	1	1	2	1	1	3	3	3	2
CO3	3	3	3	2	3	2	1	1	3	2	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
AVG.	3.00	3.00	2.75	2.25	2.75	1.50	1.25	1.25	2.25	1.50	1.50	3.00	3.00	2.75	2.50

Computer Organization & Architecture Lab
Code: PCC-CSE 392
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To get exposure with hardware description Language.
2.	To implement adder circuits using basic gates.
3.	To understand the converter circuits using basic gates.
4.	To understand the various circuits for ALU, data path and control units.

Pre-Requisite:	
1.	Digital Design concepts- Boolean algebra, Logic Gates, Combinational and Sequential Circuits etc.
2.	Foundation of Computer system design

Laboratory Experiments:	
1.	Implement the logic gates (AND, OR, XOR, NOT, NAND, NOR, XNOR) in VHDL using Data Flow Architecture.
2.	Implement the logic gates (AND, OR, XOR, NOT, NAND, NOR, XNOR) in VHDL using Behavioural Architecture.
3.	Design and implement the Half Adder circuit in VHDL using Data Flow and Behavioural Architecture.
4.	Design and implement Full Adder circuit in VHDL using Data Flow and Behavioural Architecture.
5.	Design and implement the Half Subtractor & Full Subtractor circuit in VHDL using Data Flow and Behavioural Architecture.
6.	a. Design and implement a Decoder (2X4) b. Encoder (4X2) c. 1 bit Comparator using Data flow and Behavioural Architecture.
7.	Design a MUX and DeMUX in VHDL using Data Flow Architeture

8.	Design and implement T, D and SR Flip Flop in VHDL using Behavioural architecture.
9.	Design and implement a shift registers (4 bits) using Data Flow architecture.
10.	Design and implement up & down counters(4 bits) using Data Flow architecture
11.	Design and implement an ALU (8 bit) using Data Flow architecture
12.	Design and implement a full adder using half adder using structural architecture
13.	Design and implement 4 bit parity generator using XOR Gate using structural architecture.
14.	Design and implement 8:1 MUX using 4:1 MUX using structural architecture

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text Book:

1. AMIR PALNITKAR, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall
2. Nazeih M.Botros, HDL Programming VHDL and Verilog, Dreamtech Press

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 392.1	Remember various computer organization and architecture concepts.
PCC-CSE 392.2	Apply various arithmetic operations and processor design methods.
PCC-CSE 392.3	Understand the combinational & sequential circuits using basic gates.
PCC-CSE 392.4	Analyze the architecture and functionality of central processing unit and memory hierarchy.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	3	-	-	-	3	3	-	-	-	3	2	3
CO4	3	3	3	3	-	-	-	3	3	-	-	-	3	3	2
AVG.	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**-**	**-**	**3.00**	**3.00**	**-**	**-**	**3.00**	**3.00**	**2.75**	**2.25**

IT Workshop-I (Programming with Python)
Code: PCC-CSE 393
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To master an understanding of scripting & the contributions of scripting languages.
2.	Design real life problems and think creatively about solutions.
3.	Apply a solution in a program using R/Matlab/Python.
4.	To be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.

Pre-Requisite:	
1.	Knowledge of Programming Logic.
2.	Experience with a high level language (C/C++,) is suggested.
3.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.

Practical Syllabus

Programming with Python

Introduction
History, Features, Setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator

Conditional Statements
If, If- else, Nested if-else, Looping, For, While, Nested loops. Break, Continue, Pass statement

String Manipulation
Accessing Strings, Basic Operations, String slices, Function and Methods

Lists, Tuple, Dictionaries
Introduction of lists, , Accessing list, Operations, Working with lists, Function and Methods
Introduction of tuples, Accessing tuples, Operations, Working, Functions and Methods
Introduction of dictionaries, Accessing values in dictionaries, working with dictionaries, Properties

Functions
Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

Modules
Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and Writing files, Functions

Exception Handling
Exception, Exception Handling, except clause, Try? Finally clause, User Defined Exceptions.

Working with DataFrames in Python
Loading Dataset into Pandas DataFrame, Displaying First Few Records of the DataFrame, Finding summery of the DataFrame, Slicing and indexing of DataFrame, Sorting DataFrame by columns values, creating New columns, Grouping and Aggregating, Joining DataFrames, Applying operations to multiple Columns, Filtering record based on Conditions, Calculating mean, median, mode in Pandas. Handling missing values,

Explorations of data using Visualization
Drawing plots, Bar chart, Histogram, Scatterplot

Laboratory Experiments:	
1.	Practical Assignments related with implementation of PCC-CS393

Text book and Reference books:
1. Reema Thareja– " Python Programming Using Problem Solving Approach" Oxford University Press"
2. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
3. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
4. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
6.G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

Course Outcome:	
On completion of the course students will be able to	
PCC-CSE 393.1	Describe various data types, Conditional statements and Looping structures in python and use them to solve basic python programs.
PCC-CSE 393.2	Interpret usage of List, Tuples, Set, Dictionary and Strings and use these to solve programming problems.
PCC-CSE 393.3	Develop modular programs using functions, read and write data from/to files in Python programs.
PCC-CSE 393.4	Use data analysis tools in the Pandas library and Visualize data using Matplotlib library.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	1	1	-	2	-	-	-	-	-	-	2	3	3	3
CO2	3	3	3	2	3	-	-	-	-	-	-	2	3	3	2
CO3	3	2	1	3	3	-	-	-	-	-	-	2	2	3	3
CO4	3	3	3	3	3	2	2	3	2	-	-	2	3	3	3
AVG	2.75	2.25	2.00	2.67	2.75	2.00	2.00	3.00	2.00	-	-	2.00	2.75	3.00	2.75

Detailed Syllabus for B. Tech in Computer Science & Engineering
For Academic Year 2024-2025

CSE
Second Year - Fourth Semester

Database Management Systems
Code: PCC-CSE 401
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To learn data models, conceptualize and depict a database system using ER diagram
2.	To understand the concept of Database Design in Normalization techniques
3.	To understand the internal storage structures in a physical DB design
4.	To know the fundamental concepts of transaction processing techniques
5.	To know the manipulation of SQL Queries, relational algebra queries.

Pre-Requisite:	
1.	Proper understanding of data structures and algorithms
2.	Understanding of set theory
3.	Basic programming knowledge

Unit	Content	Hrs.
1.	**Database system architecture**: Introduction to DBMS,File based system versus Database System, 3 schema architecture, Data Abstraction, Data Independence, Administration roles, types of users.	4
2.	**Data models**: Relational model- definition and Properties, Key concepts, integrity constraints**. Codd's Rules.** ER Model to Relational model. (ER Diagram –Strong entity, weak entity, binary, ternary relationship, cardinality, participation, extended ER feature)	6
3.	**Query languages**: Relational algebra (operations, Codd's algebraic rules), Evaluation of relational algebra expressions, Querying by non-procedural language (SQL)	5
4.	**Relational database design**: Single valued functional dependency, Armstrong's axioms, Normal forms (up to BCNF), Properties of decomposition. Multivalued Functional dependency, 4NF. (Overview), , Join dependency and 5NF.	9
5.	**Storage strategies**: Storage structures (Sequential, indexed sequential) Types of single level index (Primary, secondary, clustering),multi-level index, Dynamic multilevel indices using B-trees and B+ tree (Creation, insertion, deletion)	6
6.	**Transaction processing**: Concurrency control, ACID property, Serializability of scheduling (conflict and view), Locking (2PL)and timestamp-based schedulers, Database recovery techniques.	6

Text book and Reference books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,McGraw-Hill.
2."Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)
4."Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe,
5.PearsonEducation "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 401.1	Understanding Database system architecture and data models.
PCC-CSE 401.2	Design the database with normalization techniques and construct queries using Relational Algebra, SQL etc.
PCC-CSE 401.3	Develop efficient storage scheme of saving and retrieving Records and Files
PCC-CSE 401.4	Understand transaction processing, concurrency control and recovery techniques

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	1	-	-	-	-	-	-	3	1	1
CO2	2	1	2	2	1	2	1	-	-	-	1	-	3	2	1
CO3	3	2	3	1	2	2	-	2	-	-	-	-	2	2	3
CO4	2	3	3	2	-	2	2	2	2	1	-	-	3	3	1
AVG.	2.25	1.75	2.25	1.5	1.67	1.75	1.5	2	2	1	1	-	2.75	2	1.5

Object Oriented Programming
Code: PCC-CSE 402
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Introduce the principles of object-oriented programming in a higher-level programming language.
2.	Analyze a problem statement to develop a mental model of objects necessary to create software architecture.
3.	Utilize object-oriented programming to frame software architectures, with care towards separation of concerns and abstraction.
4.	Gain skills in designing, and programming software for reuse of code.
5.	Establish development methods in object-oriented programming to qualify students for teaching the language in other settings.

Pre-Requisite:	
1.	Programming Fundamentals

Unit	Content	Hrs.
1.	**OOP concepts and Overview of Java language** Class, object, Abstraction, encapsulation, Inheritance, Encapsulation Polymorphism, Difference between OOP and Procedural approach. Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java, Basic I/O operations using BufferedReader and Scanner class.	8
2.	**Objects and Classes** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, StringBuilder, this reference.	8
3.	**Inheritance, Polymorphism and Package:** Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding,, instanceOf operator, Abstract class, Interface in java. Creation of package, detailed discussion on access specifiers. Defining packages, Member access, Importing packages. Creation of packages etc. UTIL package.	8
4.	**Exception Handling and Multithreading** Exception Handling: Exception handling basics, different types of Exception classes, use of try & catch with throw, Errors in Java Program, Exceptions, throws Clause, throw Clause, Types of Exceptions, creation of user defined exception classes. Threads: Single Tasking, Multi-Tasking, thread life cycle, Uses of Threads, creating a Thread and Running it, terminating the Thread, Thread Class Methods, suspending & resuming threads, thread priorities, thread synchronization.	7
5.	**Event and GUI programming:** Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Introduction to swing. **Overview of Collections :** ArrayList, LinkedList, Vector etc.	6

Text book and Reference books:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Grew Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
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 Outcomes:	
On completion of the course students will be able to	
PCC-CSE 402.1	Apply the concepts of classes and objects to solve simple problems.
PCC-CSE 402.2	Analyze programs using inheritance, packages and interfaces.
PCC-CSE 402.3	Evaluate the use of exception handling mechanisms and a multithreaded model to solve real-world problems.
PCC-CSE 402.4	Design and develop GUI programs.

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	**PSO2**	**PSO3**
CO1	2	2	2	2	1	-	-	-	1	1	-	1	3	2	2
CO2	2	2	3	3	2	-	1	-	2	-	-	1	2	2	2
CO3	2	2	2	2	3	1	1	-	2	-	-	1	2	2	2
CO4	2	1	3	2	2	1	1	2	2	1	2	3	2	2	3
AVG.	**2.00**	**1.75**	**2.5**	**2.25**	**2.00**	**1**	**1**	**2**	**1.75**	**1**	**2**	**1.50**	**2.25**	**2.00**	**2.25**

Machine Learning
Code: PCC-CSE 403
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
2.	To design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3.	Explore supervised and unsupervised learning paradigms of machine learning.
4.	To explore Deep learning technique and various feature extraction strategies.

Pre-Requisite:	
1.	Basic understanding of Linear algebra, Trigonometry, Statistics, calculus, probability
2.	Python Programming

Unit	Content	Hrs.
1.	Some performance metrics associated with ML Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbor's, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression Support Vector Machines, Nonlinearity and Kernel Methods	12
2.	Unsupervised Learning Clustering: K-means/Kernel K-means / k-medoids Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion	9
3.	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
4.	Time-Series Data, basics of Semi-supervised Learning, Reinforcement Learning, DL fundamentals: Introduction to neural network and feed forward network	9

References:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
3. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018
4. Tom M.Mitchell, Machine Learning, McGraw-Hill,2017
5. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 403.1	To **understand** principles and concepts of various ML algorithms
PCC-CSE 403.2	To **evaluate** the ML algorithms using real life data
PCC-CSE 403.3	To **analyse** the ML algorithms according to different performance metrics
PCC-CSE 403.4	To **understand** Ensemble Methods, time series data, semi supervised learning, Reinforcement Learning, and essentials of NN architectures

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	3	3	3	1
CO2	3	2	2	2	1	-	-	-	-	1	-	3	3	3	2
CO3	3	3	2	3	1	-	-	-	-	1	-	3	3	3	3
CO4	2	3	3	3	-	-	-	-	1	2	-	3	3	3	3
AVG.	2.75	2.75	2.25	2.50	1.00	-	-	-	1.00	1.33	-	3.00	3.00	3.00	2.25

Discrete Mathematics
Code: PCC-CSE 404
Contacts: 3L+1T
Theory: 4 hrs. / Week
Credit points: 4

Course Objective:	
1.	Use mathematically correct terminology and notation.
2.	Construct correct direct and indirect proofs.
3.	To know Syntax, Semantics, Validity and Satisfiability, Graphs and Trees.
4.	Use counterexamples. Apply logical reasoning to solve a variety of problems.

Pre-Requisite:	
1.	Some concepts from basic math – algebra, geometry

Unit	Content	Hrs.
1	Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Equivalence Relation, Partial Ordering Relation, Hasse diagram, Functions, Domain and range of function Inverse and Composite Function, Bijective function, Inverse and Composite Function, Principles of Mathematical Induction, Well-ordering principle, Recursive definition, Division algorithm, Prime Numbers, Greatest Common Divisor: Euclidean Algorithm, Fundamental theorem of arithmetic, Least common multiple, Diophantine equation, Congruence, Properties of congruence, residue classes, Solution of linear congruence, Fermat's theorem, Wilson's theorem.	12
2	Basic counting techniques: Permutation and combination, Principle of inclusion and exclusion, Pigeon-hole principle.	4
3	Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	8
4	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Sub-group, Quotient Structures, Cyclic Groups,	10

	Coset, Normal Subgroups, Permutation Groups, Quotient group. Morphism: Homomorphism and Isomorphism, Kernel and Image. Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields.	
5	Graphs and Trees: Graph coloring, Chromatic number, Chromatic polynomial, Decomposition theorem, Planarity of a graph, Clique, Clique number, Independent set, Independence number, Brooke's theorem, Tree: Definition, types of tree (rooted, binary), properties of trees. Theorems of tree, Prim's and Kruskal's Algorithms to find MST. Weighted trees and prefix codes. Single source shortest path: Dijkstra's Algorithm. Tree traversal algorithms: BFS & DFS. Dual and Planar graphs, detection of planarity, Theorems on planarity. Matching, Maximal and perfect matching, Matching number, SDR of Matching, Hall Marriage theorem.	14

Text book and Reference books:

1. A text book of Discrete Mathematics, Guruprasad Samanta, New Age International.
2. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
3. J.K. Sharma, Discrete Mathematics, Macmillan
4. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
5. Douglas B. West, Introduction to graph Theory, PHI
6. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
7. N. Deo, Graph Theory, Prentice Hall of India, 1974.
8. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
9. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
10. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 404.1	Remember the concept of set theory, counting techniques, basic algebraic structures, and graphs. Discuss the logic sentence in terms of predicates, quantifiers, and logical connectives.
PCC-CSE 404.2	Derive the solution for a given problem using deductive logic and prove the solution based on logical inference. Evaluate different relations, and algorithms of number theory, logic, counting techniques, and graph theory.
PCC-CSE 404.3	Classify algebraic structure for a given a mathematical problem. Analyze algorithms and logic related to real-life problems.
PCC-CSE 404.4	Apply functions, basic and advanced principles of counting, logical equivalence, algebraic structures, and algorithms to solve complex engineering problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	-	-	2	3	3	2
CO2	3	3	3	3	2	1	1	-	2	2	2	3	3	3	1
CO3	3	3	3	3	3	2	-	-	1	1	1	3	3	3	2
CO4	3	3	2	3	3	-	-	2	3	1	2	2	3	2	3
AVG.	3.00	3.00	2.75	3.00	2.50	1.50	1.00	2.00	1.75	1.33	1.67	2.50	3.00	2.75	2.00

Formal Language & Automata Theory
Code: PCC-CSE 405
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Be able to know different classes of grammars and formal languages.
2.	Be able to write grammar and construct finite automata for different languages.
3.	Be able to know properties of regular expression and construct pushdown automata for context free grammars.
4.	Be able to understand undesirability and decide on languages that are undesirable.

Pre-Requisite:	
1.	Basics of Set Theory, Graph Theory
2.	Principle of Mathematical Induction, Proof by Contradiction

Unit	Content	Hrs.
1.	Formal Languages and Grammars: Alphabet, strings, languages, grammars, productions and derivation, Chomsky hierarchy of grammars.	6
2.	Finite Automata: deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA), NFA with epsilon, NFA to DFA conversion, equivalence of NFA and DFA, state transition graph, transition table, Mealy and Moore machine, minimization of automata.	6
3.	Regular grammar and Languages: Regular expressions and languages, regular grammars and equivalence with finite automata, properties of regular languages, Arden's theorem, closure properties of regular set, pumping lemma for regular expression.	9
4.	Context-free grammar and pushdown automata: Context-free grammars (CFG) and languages (CFL), derivation, parse trees, ambiguity in CFG, left recursion, left factoring, normal forms, Closure Properties of CFG. Pushdown automata (PDA): Definition, acceptance of strings by PDA, DPDA and NPDA, construction of PDA from CFG.	9
5.	Turing Machines and Undecidability: 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: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.	7

Text books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.

Reference books:

1. Shyamalendu Kandar, Introduction to Automata Theory, Formal Languages and Computation, PEARSON.
2. Dr. R. B. Patel, Theory of Computation, Khanna Publishing House.
3. K.L.P. Mishra (Author), N. Chandrashekaran (Author), Theory of Computer Science: Automata, Languages and Computation, Prentice-Hall of India Pvt.Ltd.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 405.1	Understand the basics of formal language, grammar, and automata.
PCC-CSE 405.2	Apply pumping lemma to disprove the language is regular language or context free language.
PCC-CSE 405.3	Remember context free grammar to design pushdown automata.
PCC-CSE 405.4	Analyze computational problems and understand decidability.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	-	-	1	1	1	1	2	-	2	3	1	2
CO2	2	3	3	2	2	1	1	1	2	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	2	2	1	-	2	3	2
CO4	2	3	3	3	1	2	2	2	3	3	2	2	3	3	2
AVG.	**2.00**	**3.0**	**3.0**	**2.33**	**1.67**	**1.50**	**1.33**	**1.33**	**2.00**	**2.25**	**1.67**	**2.00**	**2.75**	**2.50**	**2.00**

Introduction to Industrial Management (Humanities-III)

Code: HSMC-CSE 401

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Course Objective:	
1.	Gain a comprehensive understanding of industrial systems, management principles, and key concepts such as production planning, quality management, and supply chain operations.
2.	Develop practical skills in operations management, leadership, decision-making, and communication to effectively manage industrial processes, teams, and resources.
3.	Stay updated on emerging trends, technologies, and best practices in industrial management to adapt, innovate, and lead change initiatives in dynamic industrial environments.

Pre-Requisite:	
1.	N/A

Unit	Content	Hrs.
1.	**Introduction to Industrial Management:** Industrial Management –Concept Meaning and Definitions, Scope of Industrial Management, School of management thoughts – H. Fayol & F.W.Taylor	4
2.	**Production, Planning and Control:** Concept and Meaning of PPC , Job shop scheduling	4
3.	**Plant Location, Plant Layout and Work Study:** Product design process, Process selection, Types of production system (Job, Batch and Mass Production), Concept and Meaning of Plant Location, Theories of Plant Location, Plant location-factors-Urban & Rural sites comparison, Concept and Meaning of Plant Layout, Factors Affecting Plant Layout, Advantages of Plant Layout, Techniques of Plant Layout, Types of plant layouts, Work study.	6
4.	**Statistical Quality Control:** Variables - attributes, Shewart control chart for variables - X chart, R chart, - Attributes-Defective-Defect Charts for attributes-p chart, c chart (simple problems).	4

Unit	Content	Hrs.
5.	**Material Management and Purchase Management:** A) Material management- definition, functions, importance, relationship with other departments. B) Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. C) Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice. D) Inventory control: i. Definition. ii. Objectives. iii. Economic Order Quantity (EOQ) and numeric examples. iv. ABC analysis and other modern methods of analysis. E) Material Requirement Planning (MRP) concept, applications and brief details about software packages available in market.	8
6.	**Recent trends in Industrial Management:** A) ERP (Enterprise resource planning) - concept, features and applications. B) Important features of MS Project. C) Logistics- concept, need and benefits. D) Just in Time (JIT)-concept and benefits. E) Supply chain management-concept and benefits.	4

Text book and Reference books:

1. O. P. Khanna – "Industrial Engineering & Management", Dhanpat Rai Publications
2. S.C. Sharma - "Engineering Management – Industrial Engineering & Management", Khanna Book Publishing Company, New Delhi
3. A.P. Verma and K.L. Maheshwari – "Industrial Engineering and Management", Sultan Chand & Sons
4. N. Nair – "Materials Management", Tata McGraw Hill Education

Course Outcomes:	
On completion of the course students will be able to	
HSMC-CSE 401.1	Students will be able to understand and recall the fundamental concepts, principles, and theories of industrial management.
HSMC-CSE 401.2	Students will be able to apply different industrial management tools and techniques by utilizing software and implementing quality management strategies.
HSMC-CSE 401.3	Students will be able to evaluate the benefits and weaknesses of different industrial management strategies and approaches as well as they will be able to assess the market trends.
HSMC-CSE 401.4	Students will be able to assess whether the strategies are effective in the line of organizational goal and create innovative solutions to face the market challenges

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	3	2	2	2	2	2	2	2	1	2
CO2	2	1	3	2	2	1	1	1	1	1	2	3	2	3	3
CO3	1	2	3	2	1	2	2	1	1	2	2	2	2	3	3
CO4	1	2	2	3	2	1	1	1	1	2	2	2	1	2	3
AVG.	1.25	1.5	2.5	2.00	1.50	1.75	1.50	1.25	1.25	1.75	2.00	2.25	1.75	2.25	2.75

Database Management System Lab
Code: PCC-CSE 491
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.
2.	To construct the SQL queries for a given specification in Open source and Commercial DBMS – ORACLE platform.
3.	To enable the students to practice the concepts learnt in the subject Database Management System by developing a database.

Pre-Requisite:	
1.	Proper understanding of data structures and algorithms
2.	Understanding of set theory
3.	Basic programming knowledge

Laboratory Experiments:		
Structured Query Language		**No. of sessions**
1.	**Creating Database** Creating a Database Creating a Table Specifying Relational Data Types Creating Constraints	1
2.	**Table and Record Handling** INSERT, DELETE, UPDATE, TRUNCATE commands DROP, ALTER commands COMMIT, ROLLBACK commands	1
3.	**Retrieving Data from a Database** The SELECT statement Using the WHERE clause ORDER BY, GROUP BY and HAVING Clause Using Logical Operators, Using IN, BETWEEN, LIKE, IS operators Using ANY, ALL, EXISTS operator Using Aggregate Functions Combining Tables Using JOINS Subqueries(independent and correlated)	4
4.	**Database Management** Creating Views Creating Column Aliases Creating Database Users Using GRANT and REVOKE	2
5.	**Introduction to PL/SQL** Basic programming constructs (decision making, iteration) Practical implementation of Stored Procedure and function Cursor Trigger	4

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Resources

1. Sql, pl/sql the programming language of oracle by Bayross, Ivan
2. https://livesql.oracle.com/

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 491.1	Create a database schema, relation and implement referential integrity constraint.
PCC-CSE 491.2	Implement and control the database using SQL queries for a given specification in ORACLE platform
PCC-CSE 491.3	Applying administrative activities like working with views, creating users and granting or revoking privileges on database objects.
PCC-CSE 491.4	Create database objects by using Procedural extension of SQL to develop a better control on database.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	1	1	-	-	-	-	-	1	-	-
CO2	2	2	3	1	1	1	1	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	2	-	2	2	2	2	1	3	3	3
CO4	2	3	3	2	-	1	-	-	-	-	1	-	3	3	3
AVG.	2.25	2.25	2.5	2	1.5	1.25	1	2	2	2	1.5	1	2.25	2.33	3

Object Oriented Programming Lab
Code: PCC-CSE 492
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To build software development skills using java programming for real-world applications.
2.	To understand and apply the concepts of classes, packages, interfaces, inheritance,
3.	Exception handling and file processing.

Pre-Requisite:	
1.	Programming Fundamentals

Laboratory Experiments:	
1.	Assignments on basic programming. Decision control, Loop Control, Array.
2.	Assignments on class, constructor, overloading, inheritance, overriding.
3.	Assignments on Strings.
4.	Assignments on developing abstract class interfaces- multiple inheritance, extending interfaces
5.	Assignments on creating and accessing packages
6.	Assignments on multithreaded programming, Exception handling programming.
7.	Assignments on AWT and Event handling programming,collections.
	Note: Use Java for programming

(Detailed instructions for Laboratory Manual to be followed for further guidance)

1. Timothy Budd, Understanding object-oriented programming with Java, 2nd ed., Pearson, 2001
2. Herbert Schildt, The complete reference Java 2, TMH, 8th ed., 2011.
3. Beginning Programming with Java for Dummies, 5ed by Barry A. Burd

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 492.1	Understand java programs using object oriented programming concepts.
PCC-CSE 492.2	Apply the knowledge of inheritance, interface to develop Java programs.
PCC-CSE 492.3	Implement and evaluate simple applications using object oriented concepts such as package, exceptions.
PCC-CSE 492.4	Create GUIs and event driven programming applications for real world problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	-	-	-	1	1	-	2	2	3	2
CO2	2	3	3	2	2	-	-	-	1	1	-	2	3	2	2
CO3	2	3	3	2	3	1	1	-	1	2	1	2	2	3	2
CO4	3	3	3	2	3	2	1	1	2	2	2	3	3	3	3
AVG.	**2.25**	**3.00**	**2.75**	**2.00**	**2.25**	**1.50**	**1.00**	**1.00**	**1.25**	**1.50**	**1.50**	**2.25**	**2.50**	**2.75**	**2.25**

Machine Learning Lab
Code: PCC-CSE 493
Contacts: 4P
Practical: 4 hrs. / Week
Credit points: 2

Course Objective:	
1.	To understand the basic theory underlying machine learning.
2.	To be able to formulate machine learning problems corresponding to different applications.
3.	To understand a range of machine learning algorithms along with their strengths and weaknesses.
4.	To be able to apply machine learning algorithms to solve problems of moderate complexity.
5.	To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Pre-Requisite:	
1.	Statistics, Probability, Linear algebra, calculus and
2.	Programming language (Python)

Laboratory Experiments:	
1.	Study some python libraries associated with ML
2.	Write a program in python to implement linear regression in real life dataset
3.	Write a program in python to implement logistic regression in real life dataset
4.	Write a program in python to implement k-nearest neighbour algorithm to classify a real-life dataset.
5.	Write a program in python to implement Naive based algorithm in real life dataset classification.
6.	Write a program in python to demonstrate the working of decision-tree algorithm. Use an appropriate dataset for building the decision trees and apply this knowledge to classify a new sample.
5.	Write a program to demonstrate the working of SVM algorithm. Use an appropriate dataset and apply this knowledge to classify the new sample.

Laboratory Experiments:	
6.	Write a program to implement random-forest algorithm to classify real life dataset.
7.	Write a program to implement k-means algorithm to classify real life dataset.
8.	Write a program to implement principal component analysis (PCA) in real life dataset.
9.	Write a program to implement random-forest algorithm to classify real life dataset.
10.	Write a program to implement ANN algorithm to classify real life dataset.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

1. Manaranjan Pradhan and U Dinesh Kumar, machine Learning using Python, First edition, Wiley India Pvt. Ltd, 2019.
2. Andreas C.Mueller, Sarah Guido,Introduction toMachine Learning with Python guide for data scientists, O'REILLY Media, 2016.
3. Abhishek Vijayvargia, Machine Learning with Python, BPB Publications, 2018
4. Practical handbook of ML by S. Bhattacharya & S. Bhattacharya – G. K. Publication

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 493.1	**Understand** different machine learning techniques.
PCC-CSE 493.2	**Apply** the knowledge of machine learning in various practical fields.
PCC-CSE 493.3	**Analyse** the performances of different machine learning algorithms.
PCC-CSE 493.4	**Develop** machine learning models to solve real life problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	1	-	1	3	3	3
CO2	3	3	3	3	-	-	-	-	1	-	-	2	3	3	3
CO3	3	3	3	3	2	-	-	-	1	-	-	2	3	3	3
CO4	3	3	3	3	3	-	-	-	1	1	-	2	3	3	3
AVG.	3.00	3.00	3.00	3.00	2.50	-	-	-	1.00	1.00	-	1.75	3.00	3.00	3.00

Detailed Syllabus for B. Tech in Computer Science & Engineering
For Academic Year 2024-2025

CSE
Third Year - Fifth Semester

Compiler Design
Code: ESC-CSE 501
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand and list the different stages in the process of compilation.
2.	Identify different methods of lexical analysis
3.	Design top-down and bottom-up parsers
4.	Identify synthesized and inherited attributes
5.	Develop syntax directed translation schemes
6.	Develop algorithms to generate code for a target machine

Pre-Requisite:	
1.	Knowledge of automata theory, context free Languages
2.	Computer organization
3.	Data structures and simple graph algorithms, logic or algebra

Unit	Content	Hrs.
1.	**Introduction to Compiling:** Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler. The role of the lexical analyser, Tokens, Patterns, 6 Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).	6
2.	**Syntax Analysis:** The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	10
3.	**Syntax directed translation and Type checking:** Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes. Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions.	5
4.	**Run time environments:** Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	7

Unit	Content	Hrs.
5	**Intermediate code generation, code optimization and code generation:** Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples). **:** Introduction, Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization, Issues in the design of code generator, Register allocation & assignment.	8

Text Books

1. Alfred V. Aho, Jeffrey D Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education Asia, 2012.

Reference Books

1. Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003.
2. C. N. Fischer, R. J. LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2003.
3. Henk Alblas, Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
4. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Thompson Learning, 2003.
5. Jean Paul Tremblay, Paul G Serenson, "The Theory and Practice of Compiler Writing", BS Publications, 2005.
6. Dhamdhere, D. M., "Compiler Construction Principles and Practice", Second Edition, Macmillan India Ltd., New Delhi, 2008.
7. V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.

Course Outcomes:	
On completion of the course students will be able to	
ESC-CSE 501.1	Remember the fundamentals of Automata Theory and explain various phases of a compiler.
ESC-CSE 501.2	Analyse the different parsing techniques.
ESC-CSE 501.3	Learn to create intermediate code generation and understand run time environment.
ESC-CSE 501.4	Learn the use of applying code optimization and code generation.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	2	3		2	2	-	-	-	-	-	-	-	2	2	-
CO3	2	-	2	-	2	-	-	-	-	-	-	-	1	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	1	2	-
AVG.	2.00	2.5	2.00	2	2.00	-	-	-	-	-	-	2	1.50	2.00	-

Operating Systems
Code: PCC-CSE 501
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To learn the mechanisms of OS to handle processes and threads and their communication.
2.	To learn the mechanisms involved in memory management in contemporary OS.
3.	To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
4.	To know the components and management aspects of concurrency management.

Pre-Requisite:	
1.	Computer Organization &Architecture

Unit	Content	Hrs.
1.	**Introduction**: Generations Concept of Operating systems, Systems, Types of 3 Operating Systems, OS Services, System Calls, Structure of an OS, Concept of Virtual Machine. Computer system structures.	3
2.	**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.	10
3.	**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 Problematic.	5
4.	**Deadlocks**: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	5
5.	**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).	8
6.	**File Management**: Concept of File, Access methods, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping). **Disk Management**: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	6

Text book and Reference books:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, 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 Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison Wesley
6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 501.1	Understand basic concepts of operating system and process management.
PCC-CSE 501.2	Analyse various scheduling algorithms and process synchronization.
PCC-CSE 501.3	Evaluate various deadlock prevention and avoidance algorithms.
PCC-CSE 501.4	Design various memory, file and disk management schemes.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	1	1	1	1	1	-	2	2	1	2
CO2	3	3	3	3	2	-	1	-	2	2	2	2	3	3	3
CO3	2	2	2	3	2	-	-	-	2	2	1	2	2	2	3
CO4	2	3	2	3	2	-	1	1	3	2	2	3	2	3	3
AVG.	2.25	2.25	2.00	2.75	1.75	1.00	1.00	1.00	2.00	1.75	1.67	2.25	2.25	2.25	2.75

Design and Analysis of Algorithms
Code: PCC-CSE 502
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them.
2.	Through the complexity measures, different range of behaviours of algorithms and the notion of tractable and intractable problems will be understood.

Pre-Requisite:	
1.	To know data-structure and basic programming ability.

Unit	Content	Hrs.
1.	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations:Substitution method, Recursion tree method and Masters' theorem.	8
2.	**Divide and Conquer and Greedy Approach** Basic method, use, Examples – Binary Search, Merge Sort, Quick Sort and their complexity , Strassen's matrix manipulation algorithm;	7

	Basic method, use, Examples – Knapsack problem, Job sequencing with deadlines, Minimum cost spanning ree by Prim's and Kruskal's algorithm.	
3	**Dynamic Programming and Backtracking** Basic method, use, Examples – Matrix Chain Manipulation, All pair shortest paths, single source shortest path. Basic method, use, Examples – 8 queens problem, Graph coloring problem.	7
4.	Graph traversal algorithm: Breadth First Search(BFS) and Depth First Search(DFS) – Classification of edges - tree, forward, back and cross edges – complexity and comparison, topological sorting. Network Flow: Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration).	10
5.	Notion of NP-completeness: P class, NP class, NP hard class, NP complete class – their interrelationship, Satisfiability problem, Cook's theorem (Statement only), vertex cover problem and independent set problem. Approximation Algorithms: approximation scheme, polynomial time approximation schemes, vertex cover problem, travelling salesman problem.	7

Text book and Reference books:

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, Reading, MA

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 502.1	Analyzing the basic relation and the performance of an algorithm in terms of time complexity
PCC-CSE 502.2	Apply the algorithmic design paradigm (Divide and Conquer, Greedy method, dynamic programming and back tracking)
PCC-CSE 502.3	Design algorithm for Graph and Network Flow
PCC-CSE 502.4	Understand NP class of Problem and propose Approximation Algorithm for the same

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	P01	P02	P03	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	P012	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	2	-	-	2	-	2	2	3	3
CO2	3	2	2	3	2	-	2	-	-	2	-	2	2	3	3
CO3	3	3	3	3	2	-	2	-	-	2	-	2	3	3	3
CO4	3	2	3	2	2	-	2	-	1	2	-	2	3	3	3
AVG.	3	2.25	2.75	2.75	2	-	2	-	1	2	-	2	2.5	3	3

Artificial Intelligence
Code: PEC-CSE 501A
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Objective:	
1.	To offer a solid basis of underlying ideas in artificial intelligence
2.	To give a brief explanation of the objectives and workings of artificial intelligence
3.	To provide the student the ability to use these methods in applications including perception, logic, and education

Pre-Requisite:	
1.	Discrete Mathematics
2.	Understanding of Probability
3.	Basic understanding of Programming Languages

Unit	Content	Hrs.
1.	**Introduction**: Fundamentals of Artificial intelligence- Issues with AI, AI technique, Tic - Tac - Toe problem. **Intelligent Agents:** Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving:** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	8
2.	**Search techniques:** Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies:** Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search:** Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	13
3.	**Knowledge & reasoning:** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	3
4.	**Using predicate logic:** Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. **Probabilistic reasoning:** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	6
5.	**Natural Language processing:** Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. **Learning:** Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.	6

Text book and Reference books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. Stuart Russel, Peter Norvig, "AI – A Modern Approach", Second Edition, Pearson Education, 2007.

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 501A.1	Explain the modern tools of Artificial Intelligence (AI) and knowledge representation models.
PEC-CSE 501A.2	Determine the domain-specific problems solving methods using AI based algorithms and techniques.
PEC-CSE 501A.3	Evaluate knowledge based representation and learning methods for broad areas of state-of-the-art technological growth.
PEC-CSE 501A.4	Formulate the solution requirements of complex engineering problems in multidisciplinary application fields.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	1	-	-	1	3	3	1
CO2	3	3	2	1	2	-	-	-	-	-	-	2	3	2	1
CO3	2	3	1	2	2	-	-	-	1	-	2	3	2	2	3
CO4	1	3	3	2	3	-	-	2	-	1	-	2	3	2	-
AVG.	2	2.75	2	1.75	2.5	-	-	2	1	1	2	2	2.75	2.25	1.67

Human Computer Interaction

Code: PEC-CSE 501B
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Learn the foundations of Human Computer Interaction.
2.	Be familiar with the design technologies for individuals and persons with disabilities.
3.	Be aware of mobile Human Computer interaction.
4.	Learn the guidelines for user interface.

Pre-Requisite:	
1.	The course catalog lists "knowledge of C programming language/UNIX." In reality, the prerequisite is programming skill in some practical programming language such as Java, C#, HTML, or Processing.
2.	The course focuses on human-computer interaction and interface design and assumes that students will have the skills required to program prototypes of computer interfaces.
3.	Students without programming experience who wish to take this course should speak with the instructor before the second class.

Unit	Content	Hrs.
1.	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	7
2.	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	7
3.	Cognitive models –Socio-Organizational issues and stake holder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.	8
4.	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	7
5.	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	6
6.	Recent Trends: Speech Recognition and Translation, Multimodal System.	3

Text books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.
3. A Dix, Janet Finlay, G D Abowd, R Beale, Human-Computer Interaction, 3rd Edition, Pearson Publishers, 2008.
4. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.

Reference books:

1. Brian Fling, ―Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
2. Bill Scott and Theresa Neil, ―Designing Web Interfaces, First Edition, O'Reilly, 2009. (UNIT-V).

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 501B.1	Understand the design and development processes and life cycle of Human Computer Interaction.
PEC-CSE 501B.2	Apply the interface design standards/guidelines for cross cultural and disabled users.
PEC-CSE 501B.3	Analyze the interface design standards/guidelines for cross cultural and disabled users.
PEC-CSE 501B.4	Design and Develop Human Computer Interaction in proper architectural structures.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	3	2	2	3	2	2	2	3	2	3
CO2	3	2	1	3	2	2	-	3	3	3	3	3	3	1	-
CO3	2	2	3	2	2	1	-	1	3	3	3	1	2	-	1
CO4	3	2	2	2	-	2	3	1	3	2	3	2	-	3	1
AVG.	2.50	1.75	2.00	2.00	1.67	2.00	2.50	1.75	3.00	2.50	2.75	2.00	2.67	2.00	1.67

Computer Graphics
Code: PEC-CSE 501C
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Objective:	
1.	The main objective of the course is to introduce students with fundamental concepts and theory of computer graphics.
2.	It presents the important drawing algorithm, polygon fitting, clipping and 2D transformation curves and an introduction to 3D transformation.
3.	To make the students know about various curve and surface representation methods
4.	To make the students understand about various hidden surface removal algorithms, and lighting and shading models.

Pre-Requisite:	
1.	Knowledge of data structures and algorithm is preferable
2.	Knowledge of Linear Algebra

Unit	Content	Hrs.
1.	**Introduction to computer graphics & graphics systems**: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB colour model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	6
2.	**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.	8
3.	**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 view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	10
4.	Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method 3D transformation & viewing [5L]: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.	6
5.	**Curves [3L]:** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. **Hidden surfaces [3L]:** 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. **Colour & shading models [2L]:** Light & colour model; interpolative shading model; Texture. **Introduction to Ray-tracing [3L]:** Human vision and colour, Lighting, Reflection and transmission models.	6

Text book and Reference 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. Foley, J. D., Dam, A.V, Feiner, S. K., & Hughes, J. F. (1995). Computer Graphics: Principles and Practice in C. 2nd edition. Addison-Wesley Professional.
5. Bhattacharya, S. (2018). Computer Graphics. Oxford University Press
6. Marschner, S., & Shirley, P. (2017) Fundamentals of Computer Graphics. 4th edition. CRC Press

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 501C.1	Understanding computer graphics system, display devices and various application areas of graphics.
PEC-CSE 501C.2	Applying scan conversion algorithms for line, circle and ellipse with examples.
PEC-CSE 501C.3	Analyzing and illustrating 2D and 3D transformation operations such as translation, rotation, scaling, etc.
PEC-CSE 501C.4	Evaluating any kind of 3D objects using viewing, clipping and projection techniques.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	1	-	2	-	1	-
CO2	3	2	2	3	1	-	-	1	2	-	1	2	1	2	-
CO3	3	3	3	2	2	2	1	-	2	-	-	3	2	1	2
CO4	3	3	3	3	2	-	-	2	3	-	1	2	2	2	-
AVG.	3.00	2.25	2.67	2.67	1.67	2.00	1.00	1.50	2.33	1.00	1.00	2.25	1.67	1.50	2.00

Operations Research
Code: OEC-CSE 501A
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To comprehend and use operations research methods to analyse and solve your operational challenges in real life.
2.	To formulate and apply the techniques of Linear Programming and the extended topics to solve certain optimization problems

Pre-Requisite:	
1.	Knowledge of probability distributions and statistics, and preferably basic calculus, for learning Simulation.

Unit	Content	Hrs.
1.	**Linear Programming Problem (LPP):** Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution,	12

	Convex set and explanation with examples Solution of LPP by Simplex Method; Charnes' Big-M Method; Duality Theory.	
2.	**Transportation Problem:** Basic concept, Different solution methods, Optimality test. **Assignment Problem:** Problem formulation, Solution methods, Travelling Salesman Problem. **Game Theory**: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.	9
3.	**Network Analysis**: Shortest Path: Floyd Algorithm; Maximal Flow Problem: Ford-Fulkerson; PERT & CPM (Cost Analysis, Crashing, Resource Allocation excluded).	6
4.	**Queuing Theory**: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems. **Inventory Control**: Introduction to EOQ Models of Deterministic and Probabilistic; Safety Stock; Buffer Stock. **Sequencing:** Johnson's algorithm	9

Text book and Reference books:

1. H. A. Taha, "Operations Research", Pearson
2. P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House
3. Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency
4. Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA

Course Outcome:	
On completion of the course students will be able to	
OEC-CSE 501A.1	Recall the fundamental principles and formulas related to linear algebra and linear inequalities.
OEC-CSE 501A.2	Demonstrate a comprehensive understanding of the theoretical principles and applications of linear algebra, convex & concave combination, graph theory and stochastic process necessary for engineering practice by enhancing the power of knowledge.
OEC-CSE 501A.3	Apply advanced techniques in LPP, Transportation problem, Game theory, Network analysis, Inventory theory and Queuing theory to solve complex mathematical problems and analyze linear dependency & independency, types of solutions, loop formation, steady state in optimization and multivariable analysis.
OEC-CSE 501A.4	Analyze multidisciplinary problems using different mathematical models and create a model and build a path by which a complex multidisciplinary engineering problem can be solved.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	-	2	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	2	3	3	3	3
CO4	3	3	2	3	3	-	-	-	-	-	2	2	3	3	2
AVG.	3.00	3.00	2.50	3.00	2.50	-	-	-	-	-	2.00	2.50	3.00	3.00	2.50

Multimedia Systems
Code: OEC-CSE 501B
Contacts: 3L
Theory: 3 hrs. / Week

Course Objective:	
1.	To understand various components of the multimedia systems
2.	To introduce how multimedia can be used in various application areas.
3.	To provide a solid foundation to the students so that they can identify the proper applications of multimedia, evaluate the appropriate multimedia systems and develop effective multimedia applications.

Pre-Requisite:	
1.	Knowledge in Data Structure, Computer Network and Operating System.

Unit	Content	Hrs.
1.	**Introduction**: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications.	2
2.	**Text and Audio, Image and Video:** Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.	10
3.	**Synchronization, Storage models and Access Techniques**: Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems (traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, and CCD.	8
4.	**Image and Video Database, Document Architecture and Content Management:** Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- kd trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing, Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications.	12
5.	**Multimedia Applications**: Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors.	5

Text book and Reference books:

1. Ralf Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communications & Applications, Pearson Ed.
2. Nalin K. Sharda, Multimedia Information System, PHI.
3. Fred Halsall, Multimedia Communications, Pearson Ed.
4. Koegel Buford, Multimedia Systems, Pearson Ed.
5. Fred Hoffstetter, Multimedia Literacy, McGraw Hill.
6. Ralf Steinmetz and Klara Nahrstedt, Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing, PHI.
7. J. Jeffcoate, Multimedia in Practice: Technology and Application, PHI.

8. V.K. Jain, Multimedia and Animation, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Course Outcome:	
On completion of the course students will be able to	
OEC-CSE 501B.1	Analysing the range of concepts, techniques and tools for creating and editing the interactive multimedia applications
OEC-CSE 501B.2	To understand the hardware and software needed to create projects using creativity and organization to create them.
OEC-CSE 501B.3	To apply the concepts of Synchronization, Storage models and Access Techniques.
OEC-CSE 501B.4	To evaluate the approaches for Image and Video Database, Document Architecture , Content Management to develop a complete project.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	1	1	1	1	1	2	2	1	2
CO2	2	2	3	2	2	2	1	-	2	1	2	3	-	2	1
CO3	2	1	3	3	2	2	-	-	2	-	2	3	2	3	2
CO4	3	2	2	3	2	-	1	2	1	2	3	2	3	1	2
AVG.	2.50	1.75	2.50	2.75	2.25	1.67	1.00	1.50	1.50	1.33	2.00	2.50	2.33	1.75	1.75

Introduction to Philosophical Thoughts
Code: OEC-CSE 501C
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To inspire the student to confront the philosophical problems implicit in the experience of self, others and the universe, together with the question of their relations to ultimate transcendence (God and immortality);
2.	To develop in the student habits of clear, critical thinking within the framework of both an adequate philosophical methodology and accepted norms of scholarship;
3.	To introduce the student to reading critically the great philosophers, past and present
4.	Finally, to help the student to formulate for himself or herself a philosophy of life or world-view consistent with the objectives of liberal education at a Catholic university.

Pre-Requisite:	
1.	Multiple Measures Placement in GE-level writing, or completion of 113A or 114A, or completion of the lower division writing requirement.

Unit	Content	Hrs.
1.	**Nature of Indian Philosophy**: Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanisadic views: Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta, Rna.	10
2.	**Carvaka school**: its epistemology, metaphysics and ethics. Mukti	9
3.	**Jainism**: Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada; pramanas, ahimsa, bondage and liberation.	7
4.	Buddhism: theory of pramanas, theory of dependent origination, the four noble truths; doctrine of momentaryness; theory of no soul. The interpretation of these theories in schools of Buddhism: Vaibhasika, Sautrantrika, Yogacara, Madhyamika.	5

5.	Nyaya: theory of Pramanas; the individual self and its liberation; the idea of God and proofs for His existence.	5

Text book and Reference books:

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 Upanisadic 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 Outcome:	
On completion of the course students will be able to	
OEC-CSE 501C.1	Understand and explain philosophically important theories and concepts that have historically been used to organize and explain human experience.
OEC-CSE 501C.2	Apply philosophical methods and principles to analyse real-world issues and dilemmas.
OEC-CSE 501C.3	Analyse the arguments presented in philosophical texts and contemporary philosophical discourse.
OEC-CSE 501C.4	Evaluate the strengths and weaknesses of various philosophical theories and positions.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	1	2	2	3	1	2	-	3	2	2	2
CO2	-	-	2	2	-	1	2	3	2	1	-	3	2	1	2
CO3	-	-	2	1	-	2	2	3	1	2	-	3	1	2	2
CO4	-	-	2	-	-	2	2	3	1	2	-	3	2	2	2
AVG.	1.00	1.00	2.25	1.33	1.00	1.75	2.00	3.00	1.25	1.75	-	3.00	1.75	1.75	2.00

Project Management and Entrepreneurship (Humanities-IV)
Code: HSMC-CSE 501
Contact: 2L+1T
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	The course aims to bridge the gap between project management principles and entrepreneurial practices, enabling students to apply project management methodologies within the dynamic and innovative context of entrepreneurship.
2.	Another key objective is to foster the development of entrepreneurial skills, such as creativity, leadership, and adaptability, and cultivate an entrepreneurial mind-set characterized by resilience, risk-taking, and opportunity recognition.
3.	The course seeks to prepare students for launching and managing start-up ventures by equipping them with the knowledge, tools, and practical experience needed to identify viable business

	opportunities, develop comprehensive business plans, and execute entrepreneurial projects effectively.

Unit	Content	Hrs.
1.	**Basic Concepts of Project Management:** Definition and types of project, Project life cycle, Project constraints, Organizational structures for projects, Responsibilities of project manager, Project risk analysis, Project appraisal.	4
2.	**Environmental and social aspects of project:** Environmental considerations in project evaluation, Primary issues and secondary issues in Feasibility study, Social cost benefit analysis, Managing Project Risks, Contingency Planning, Project Audit Process and Closure.	4
3.	**Network analysis:** Network modeling of a project, Activity on Arrow (AOA), Forward and backward pass computation, Critical paths, floats and slack, Project Scheduling Techniques, PERT, CPM Models, Time-Cost Trade-off in a project, Project Monitoring Techniques, Gnatt chart, Line of Balance (LoB).	10
4.	**Foundation of Entrepreneurship:** Entrepreneurship and Intrapreneurship (comparisons), India's Start up Revolution, Rural and Social Entrepreneurship, Key attributes of an entrepreneur, women entrepreneurship, Myths and realities of entrepreneurship, Transition from college/ regular job to the world startups.	6
5.	**Project Financing for entrepreneurs:** Venture Capitalist, Role of Incubators and Angel Investors, Private Equity, Crowd sourcing, Overview of debt financing, Examples of project management softwares.	6

Text Books and References

1. Project Management by Prasanna and Chandra, Tata McGraw Hill.
2. Elements of Project Management by Pete Spinner, Prentice Hall, USA.
3. A course in PERT and CPM by R. C. Gupta, Dhanpat Rai Publications(P) Ltd, Delhi.
4. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
5. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
6. Business, Entrepreneurship and Management: Rao, V. S. P Vikas

Course Outcome:	
On completion of the course students will be able to	
HSMC-CSE 501.1	Students will demonstrate the ability to integrate project management principles, methodologies, and tools with entrepreneurial practices to effectively plan, execute, and manage projects within startup ventures.
HSMC-CSE 501.2	Students will be able to identify and evaluate business opportunities by applying project management techniques such as feasibility analysis, market research, and risk assessment, enabling them to make informed decisions regarding new venture creation.
HSMC-CSE 501.3	Students will develop an entrepreneurial mindset characterized by creativity, innovation, and adaptability, as well as leadership skills necessary to drive entrepreneurial initiatives, lead project teams and navigate uncertainties inherent in startup environments.
HSMC-CSE 501.4	Students will acquire the knowledge and skills needed to effectively execute and manage entrepreneurial projects, including project planning, resource allocation, time management and stakeholder communication, ensuring successful project delivery within budget and schedule constraints.

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO3	3	1	3	2	1	1	1	1	1	3	2	3	3	1	3
CO3	3	2	2	2	1	1	1	1	1	3	2	3	3	2	3
CO2	2	3	3	3	2	2	2	3	2	2	2	3	3	1	2
CO1	2	3	3	3	2	2	3	3	3	2	2	3	3	2	1
Avg	2.5	2.25	2.75	2.5	1.5	1.5	1.75	2	1.75	2.5	2.00	3.00	3.00	1.5	2.25

Operating System Lab
Code: PCC-CSE 591
Contacts: 4P
Practical: 4 hrs. / Week

Course Objective:	
1.	To install windows operating systems.
2.	To understand the basics of Unix command and shell programming.
3.	To implement various CPU scheduling algorithms.
4.	To implement Deadlock Avoidance and Deadlock Detection Algorithms
5.	To implement Page Replacement Algorithms
6.	To implement various memory allocation methods.

Pre-Requisite:	
1.	Basic programming knowledge.

Unit	Content	No. of sessions
1.	**Managing Unix/Linux Operating System:** Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, and 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, Password file management, Password security, 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.	5
2.	**Process:** Starting new process, implement child, parent and grandparent process, waiting for a process, zombie process, orphan process.	2
3.	**Signal:** Signal handling, sending signals, signal interface, signal sets.	2
4.	**CPU scheduling algorithms:** Implement various cpu scheduling algorithm using C programming language.	2
5.	**Threads:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)	1
6.	**Inter-process communication:** Pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO), message passing & shared memory (IPC).	1

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

1. Richard Stevens, Stephen Rago, Advanced Programming in the UNIX Environment, Pearson Education, 2/e.
2. UNIX : Concepts and Applications | 4th Edition by Sumitabha Das.
3. The C Odyssey: UNIX: v. 3 by Vijay Mukhi.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 591.1	Understand elementary UNIX system commands used for UNIX operating system.
PCC-CSE 591.2	Apply the knowledge of shell program to solve various complex problems.
PCC-CSE 591.3	Evaluate process creation concepts, different CPU scheduling algorithms and user threads.
PCC-CSE 591.4	Design different IPC techniques and synchronization problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	1	2	1	1	1	2	2	2	2
CO2	2	2	2	2	2	-	2	-	2	2	2	2	3	2	3
CO3	2	2	2	2	2	-	2	-	2	2	2	2	2	2	3
CO4	2	2	3	3	2	-	2	-	2	2	2	2	2	2	3
AVG.	1.75	2.00	2.00	2.25	1.75	1.00	1.75	2.00	1.75	1.75	1.75	2.00	2.25	2.00	2.75

Design and Analysis of Algorithm Lab

Code: PCC-CSE 592
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	Ability to develop C programs for computing and real-life applications using basic elements like control statements, arrays, functions, pointers and strings, and data structures like stacks, queues and linked lists.
2.	Ability to Implement searching and sorting algorithms.

Pre-Requisite:	
1.	Pre-requisites as in PCC-CS301

Laboratory Experiments:	
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 an array of integer using Divide and Conquer approach.
Dynamic Programming:	
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
Backtracking:	
6.	Implement 8 Queen problem
7.	Graph Coloring Problem
Greedy method:	
8.	Knapsack Problem
9.	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
Graph Traversal Algorithm:	
10.	Implement Breadth First Search (BFS) Implement Depth First Search (DFS)

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 592.1	**Analyze** different types of applications of Divide & Conquer techniques
PCC-CSE 592.2	**Understanding** the implementation of Dynamic Programming techniques
PCC-CSE 592.3	**Apply** backtracking and Greedy method for different types of algorithm
PCC-CSE 592.4	**Evaluate** and Implement the Graph Traversal Algorithms

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	2	-	-	2	-	2	2	3	3
CO2	3	2	2	3	2	-	2	-	-	2	-	2	2	3	3
CO3	3	3	3	3	2	-	2	-	-	2	-	2	3	3	3
CO4	3	2	3	2	2	-	2	-	1	2	-	2	3	3	3
AVG.	3	2.25	2.75	2.75	2	-	2	-	1	2	-	2	2.5	3	3

IT Workshop-II (Web Programming)
Code: PCC-CSE 593
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To introduce scripting language concepts for developing client-side applications.
2.	Comprehend the basics of the internet and web terminologies.
3.	Familiar with client server architecture and able to develop web applications.
4.	Students will gain the skills to develop project-based experience .

Pre-Requisite:	
1.	Basic Object Oriented Programming Concepts are required.
2.	How the internet works, including concepts like IP addresses, DNS, and how web browsers interact with servers.
3.	Knowing how HTTP requests and responses work.

Unit	Content	Hrs.
1.	DHTML (HTML , CSS , Java Script): HTML: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, LayoutForm, Iframe, Colors, Colorname, Colorvalue.Image Maps: map, area, attributes of image area. CSS: Panels , Borders , Padding , Margins , Display,Buttons ,Notes , Quotes , Alerts , Images , Tags , Icons. Java Script : Statements, Syntax, Comments , Operators, Data Types , Functions , Objects , Events, Strings , Arrays , Math, Errors , Scope , Classes , Modules.	4
2.	AngularJS: Directives, Model, Data Binding , Controllers, Scopes , Filters , DOM , Events, Forms, Validation, API.	2
3.	Node.js: Modules, HTTP Module, File System , URL Module, NPM ,Events , Upload Files , Email.	2
4.	Applet: Preparing to write Applets, Building Applet code, Applet Tag, Passing parameters to Applets, Adding Applet to HTML file.	2
5.	PHP&MySql: PHP :Install ,Syntax , Comments, Variables , Echo / Print, Data Types, Strings, Numbers, Casting, Math, Constants, Magic Constants, Operators ,If...Else...Elseif, Switch, Loops, Functions , Arrays , Superglobals , RegEx ,Forms ,Form Handling , Form Validation. MySql :Database, Connect, Create DB, Create Table, Insert Data, Get Last ID, Insert Multiple, Prepared, Select Data, Order By, Delete Data, Update Data, Limit Data.	3
6.	Extensible Markup Language: Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts: Introduction, Environment Variable, GET and POST Methods.	1

Text book and Reference books:

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5, 7, 8, 9).
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.
3. AchyutGodbole,AtulKahate"WebTechnologies:TCP/IP,Web/JavaProgramming, and CloudComputing",Third Edition,McGrawHill Education.

Course Outcome:	
On completion of the course students will be able to	
PCC-CSE 593.1	Understand and develop a dynamic webpage by the use of java script and DHTML
PCC-CSE 593.2	Apply and evaluate the need for secured web application development with client-side, server-side scripting languages.
PCC-CSE 593.3	Analyse web programming and connection with DBMS and perform different SQL operations using MySql.
PCC-CSE 593.4	To create small interactive web modules using modern tools following the professional web based engineering solutions, ethics and management techniques.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	1	1	-	1	-	2	2	2	1
CO2	2	2	3	2	1	-	-	2	2	-	2	-	1	1	1
CO3	1	3	2	3	2	2	2	-	3	-	1	1	2	3	2
CO4	1	1	2	2	2	1	-	2	-	2	3	2	1	1	1
AVG.	1.50	2.00	2.25	2.25	1.75	1.33	1.5	1.67	2.5	1.5	2	1.67	1.50	1.75	1.25

Detailed **Syllabus for B. Tech in Computer Science & Engineering**
For Academic Year 2024-2025

CSE
Third Year - Sixth Semester
(Semester VI)

Cloud Computing
Code: PCC-CSE 601
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand the concepts of Cloud Computing and virtualization.
2.	To learn Resource and sharing through virtualization ensuring security.
3.	To learn cloud technologies.
4.	To develop cloud environment to utilize resources fully.

Pre-Requisite:	
1.	Distributed computing, Computer Networks

Unit	Content	Hrs.
1.	**Distributed Computing and Enabling Technologies, Cloud Fundamentals:** Cloud Definition, Evolution, Architecture, Applications, deployment models, service models. **Virtualization:** Issues with virtualization, virtualization technologies and architectures, internals of virtual machine monitors/hypervisors, virtualization of data centres and issues with Multi-tenancy.	10
2.	**Resource Management and Load Balancing:** Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques.	10
3.	**Cloud technologies and Advancements:** Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack Federation in the Cloud , Four Levels of Federation, Federated Services and Applications, Future of Federation	8
4.	**Cloud Security:** Infrastructure Security, Network level security, Host level security, Application level security, Data privacy and security Issues. Access Control and Authentication in cloud computing.	5
5	**Implementation:** Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source	5

	tools, Deployment of Web Services from Inside and OutsideCloud Architecture. MapReduce and its extensions to Cloud Computing, HDFS, and GFS.	

Text book and Reference books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, 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

Course Outcome:	
On completion of the course students will be able	
PCC-CSE 601.1	To understand the evolution of cloud architecture, virtualization through early computing concepts.
PCC-CSE 601.2	To learn resource provisioning and load distribution techniques in cloud.
PCC-CSE 601.3	To analyse technologies behind cloud deployment considering security issues.
PCC-CSE 601.4	To apply the cloud deployment knowledge and tools for creating cloud environment.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	2	-	2	-	2	1	1	3	3	2
CO2	3	2	2	1	-	-	2	2	-	2	-	1	3	3	2
CO3	3	3	2	2	3	2	3	2	1	2	2	3	3	3	3
CO4	3	3	3	3	3	3	2	2	3	2	2	3	3	3	3
AVG.	3.00	2.25	2.00	2.00	3.00	2.33	2.33	2.00	2.00	2.00	1.67	2.00	3.00	3.00	2.50

Computer Networks
Code: PCC-CSE 602
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand the concept of layering in networks.
2.	To know the functions of protocols of each layer of OSI and TCP/IP protocol suite.
3.	To visualize the end-to-end flow and error control mechanisms.
4.	To familiarize the functions and protocols of different layers

Pre-Requisite:	
1.	Basic mathematics
2.	Basic understanding of computer algorithms

Unit	Content	Hrs.
1.	**Introduction:** History and development of computer networks, networks topologies. Layering and protocols, Different types of transmission media	5
2.	**Physical Layer:**, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.), LAN: Design, specifications of popular technologies, switching. Design of LAN of a campus or a building, FDM & TDM	7

Unit	Content	Hrs.
3.	**Data Link Layer:** Error detection (Parity, CRC) & correction (Hamming distance), Sliding Window, Stop and Wait protocols. Go back – N ARQ, Selective Repeat ARQ **Medium Access Control Sub Layer**: MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth and WiMax	8
4.	**Network Layer:** Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation (NAT).	6
5.	**Transport Layer:** UDP, TCP Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc.	5
6.	**Application Layer:** Examples: DNS, SMTP, IMAP, HTTP etc.; Basics of Firewalls and Cryptography.	5

Text book and Reference books:

1. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013
3. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Fifth Edition, Prentice Hall, 2011
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
6. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 602.1	Understand the layered communication architectures and it's functions in computer networks.
PCC-CSE 602.2	Apply the basics of how data flows from one station to another through physical medium
PCC-CSE 602.3	Analyze Flow and Error Control mechanisms and protocols for LAN technologies
PCC-CSE 602.4	Evaluate the protocols for various functions in the network

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-		-	-	-	2	3	2	-
CO2	3	3	2	1	2	-	-			-	-	2	3	3	-
CO3	3	3	3	1	2	-	-			-	-	2	3	3	-
CO4	3	3	3	1	3	1	-	1	3	-	-	2	3	3	3
AVG.	2.75	2.75	2.50	1.00	2.25	1.00	-	1.00	3.00	-	-	2.00	3.00	2.75	3.00

Introduction to Cyber Security & Blockchain Technology
Code: PCC-CSE 603
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	1. To make familiar with security, threat, web security of information system.
2.	To develop an understanding the different types of cyber fraud, cybercrime and cyber law.
3.	To understand the current trends of Blockchain.
4.	To understand the mechanisms of Bitcoin, Ethereum, Hyperledger

Pre-Requisite:	
1.	Data structures, Distributed systems, Computer Networks. Engineering Mathematics .
2.	Basic programming skills

Unit	Content	Hrs.
1	Introduction to Cyber Security: Introduction, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy and law. Security attacks (active and passive): With respect to information security attacks, computer security attacks, network security attacks that means cyber security attacks	10
2	Cryptography: Introduction to Cryptography and related mathematics Modern Cryptography: Symmetric key (DES, Blowfish, AES etc.) & Asymmetric key Cryptography (RSA, ElGamal, etc) Key management and authentication: Hash function (MD5, SHA1), Digital signature, Signcryption -, Kerberos	10
3.	Blockchain: Application of cryptography: Introduction, centralize and Decentralize system, Distributed Database, Comparison of Database Systems, Advantage over conventional distributed database, Distributed consensus algorithms, Blockchain Technology Mechanisms & Networks, Objective of Blockchain, Blockchain Challenges, Transactions, Merkle Tree, private vs. public Blockchain, Mining Mechanism, applications of Blockchain.	8
4.	Cryptocurrency: an application of Blockchain: Introduction, what is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.	8

Text book and Reference books:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security, Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities, Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice, Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Application by Lorne Lantz, O'Reilly Media; 1st edition.

6. Blockchain Technology: Concepts and Applications, Kumar Saurabh , Ashutosh Saxena, Wiley.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 603.1	Understand the different types of cyber fraud, cybercrime and cyber law. Get familiar with security, threat, web security of information system.
PCC-CSE 603.2	Understand cryptography basics, algorithms and mathematical background for cryptography. Analyze the important cryptographic algorithms.
PCC-CSE 603.3	Understand the basics of Blockchain technology along with its primitives. Analyze the Blockchain techniques for use cases like Finance and Trade/Supply.
PCC-CSE 603.4	Develop private Blockchain environment and develop a smart contract on Ethereum. Identify and analyze the applications of Bitcoin script.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	3	3	3	-	-	-	-	2	2	3	2
CO2	3	2	-	3	2	-	-	2	-	-	-	-	3	3	2
CO3	2	3	-	3	2	-	2	-	-	-	2	-	3	3	2
CO4	2	2	2	3	3	-	2	-	-	-	-	-	3	2	1
AVG.	2.50	2.50	2.00	3.00	2.50	3.00	2.33	2	-	-	2.00	2.00	2.75	2.75	1.75

Advanced Algorithms
Code: PEC-CSE 601A
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

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

Pre-Requisite:	
1.	Algorithm Design and Analysis

Unit	Content	Hrs.
1.	**Sorting**: Review of various sorting algorithms, topological sorting. **Graph**: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	5
2.	**Matroids**: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching**: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	7

Unit	Content	Hrs.
3.	**Flow-Networks**: Maxflow-mincut theorem, Ford Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations**: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	7
4.	**Modulo Representation of integers/polynomials**: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT)**: In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	9
5.	**Linear Programming**: Geometry of the feasibility region and Simplex algorithm. **NP-completeness**: Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	8

Text book and Reference books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 601A.1	Understand the complexity/performance of different algorithms.
PEC-CSE 601A.2	Applying the appropriate data structure for solving a particular set of problems.
PEC-CSE 601A.3	Analyze the different problems in various classes according to their complexity.
PEC-CSE 601A.4	Capable to Evaluate recent activities in the field of the advanced data structure

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	1	1	-	2	3	3	1
CO2	3	3	3	3	2	-	-	-	1	-	-	-	3	2	1
CO3	3	3	3	3	2	1	-	-	1	-	-	-	2	2	1
CO4	3	3	3	3	-	-	-	-	1	1	2	2	-	1	3
AVG.	3.00	3.00	3.00	2.75	2.00	1.00	-	-	1.00	1.00	2.00	2.00	2.67	2.00	1.50

Distributed Systems
Code: PEC-CSE 601B
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Pre-Requisite:	
1.	Computer networking, operating systems, Database Management Systems.

Unit	Content	Hrs.
1.	**Introduction:** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts. **Distributed Database Management System Architecture:** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.	9
2.	**Distributed Database Design:** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation. **Semantics Data Control:** View management; Data security; Semantic Integrity Control. **Query Processing Issues:** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	7
3.	**Distributed Query Optimization:** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms. **Transaction Management:** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models. **Concurrency Control:** Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	9
4.	**Reliability issues in DDBSs**: Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm	3
5.	**Parallel Database Systems:** Parallel architectures; parallel query processing.	4
6.	**Advanced Topics:** Mobile Databases, Distributed Object Management, Multi-databases.	4

Text book and Reference books:

1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, AddisonWesley, 1992.
3. Distributed Database Systems, Chhanda Ray, 2008, Pearson.
4. Distributed Databases: Principles and Systems, Stefano Ceri, Giuseppe Pelagatti, Indian Edition, 2017, Mc Grew Hill.

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 601B.1	Learn the principles, architectures, algorithms and programming models used in distributed systems.
PEC-CSE 601B.2	Apply knowledge of distributed systems techniques and methodologies.
PEC-CSE 601B.3	Explain the design and development of distributed systems and distributed systems applications.
PEC-CSE 601B.4	Explore Reliability and recovery protocol algorithm, Discuss the design of parallel architectures and processing, and understand the implementation of distributed and multi databases.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	-	-	-	-	1	-	3	2	1
CO2	1	3	3	2	2	-	-	-	-	-	-	2	3	3	2
CO3	2	3	2	3	1	-	3	1	-	1	3	2	1	2	2
CO4	2	3	3	3	3	1	1	2	3	-	1	3	3	3	2
AVG.	2.00	2.50	2.50	2.25	2.00	1.00	2.00	1.50	3.00	1.00	1.67	2.33	2.50	2.50	1.75

Image Processing
Code: PEC-CSE 601C
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To introduce the concepts of image processing and basic analytical methods to be used in image processing.
2.	To familiarize students with image enhancement techniques.
3.	To understand image restoration techniques.
4.	To introduce segmentation and morphological processing techniques.

Pre-Requisite:	
1.	Concepts of Digital Signal Processing

Unit	Content	Hrs.
1.	**Introduction:** Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display. A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Sampling & Quantization - Uniform & Non uniform.	4
2.	**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.	8
3.	**Image Enhancement:** Spatial Domain Method, Frequency Domain Method, Contrast Enhancement - Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High pass Filtering, High- boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8

Unit	Content	Hrs.
4.	**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.	6
5.	**Morphological image processing and Image Segmentation:** Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Basic Morphological Algorithms – Boundary extraction and Region Filling. Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	10

Text book and Reference books:

1. Rafael C. Gonzalez, Richard E. Woods – "Digital Image Processing (3rd Ed. 2007)" - Pearson
2. S Jayaraman, S Esakkirajan, T Veerakumar – "Digital Image Processing (2nd Ed.)" – TMH
3. S. Sridhar – "Digital Image Processing (2nd Ed.)" – TMH
4. B. Chanda, D. Dutta Majumder – "Digital Image Processing and Analysis (2nd Ed.)" – PHI
5. Anil K. Jain – "Fundamentals of Digital Image Processing" - PHI.
6. S. Annadurai, R. Shanmugalakshmi – "Fundamentals of Digital Image Processing, 2016" - Pearson.

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 601C.1	Understand the fundamental concepts of image processing.
PEC-CSE 601C.2	Analyze the images in the spatial and frequency domain.
PEC-CSE 601C.3	Evaluate the techniques for image enhancement and image restoration.
PEC-CSE 601C.4	Understand the image morphological processing and segmentation techniques.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	-	-	1	-	-	-	1	1	-	-
CO2	3	2	2	2	3	-	-	-	1	3	2	3	3	2	3
CO3	2	3	2	2	3	-	-	1	1	-	-	2	2	2	2
CO4	1	2	3	-	1	-	-	-	-	-	-	2	2	2	2
AVG.	2.00	2.33	2.33	2.00	2.00	-	-	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.33

Parallel and Distributed Algorithms

Code: PEC-CSE 602A
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
2.	To study the main classes of parallel algorithms
3.	To study the complexity and correctness models for parallel algorithms.

Pre-Requisite:	
1.	Basic understandings of distributed systems
2.	Knowledge of sequential algorithms and their analysis.
3.	Basic knowledge of formal models of computation

Unit	Content	Hrs.
1.	**UNIT-I**: Basic Techniques, Parallel Computers for increase Computation speed and Parallel & Cluster Computing.	6
2.	**UNIT-II**: Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples.	6
3.	**UNIT-III**: Pipelining- Techniques computing platform, pipeline programs examples.	8
4.	**UNIT-IV**: Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP.	10
5.	**UNIT-V**: Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.	5

Text book and Reference books:

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.
2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 602A.1	Understand the parallel and distributed computing techniques and methodologies.
PEC-CSE 602A.2	Apply design, development, and performance analysis of parallel and distributed applications.
PEC-CSE 602A.3	Evaluating the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.
PEC-CSE 602A.4	Analyze modeling and performance of parallel programs with complex problems and shared memory programming .

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	2	2	1	1	-	2	3	2	3	2
CO2	3	2	2	1	1	-	-	-	-	1	1	2	3	3	3
CO3	3	3	2	2	2	-	2	-	2	2	-	2	3	3	3
CO4	3	3	3	3	2	3	2	2	2	1	2	3	3	2	1
AVG.	2.75	2.25	2.25	1.75	1.50	2.5	2	1.5	1.67	1.33	1.67	2.50	2.75	2.75	2.25

Data Mining
Code: PEC-CSE 602B
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To introduce students to to the field of data mining (also known as knowledge discovery from data, or KDD for short).
2.	To study fundamental data mining concepts and techniques for discovering interesting patterns from data in various applications.
3.	To to study techniques for developing effective, efficient, and scalable data mining tools.

Pre-Requisite:	
1.	Basic database concepts such as schema, ER model, Structured Query language

Unit	Content	Hrs.
1.	**Introduction to Data Mining** Related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications	4
2.	**Data Warehouse and OLAP** Data Warehouse and DBMS, Multidimensional data model, OLAP operations Example: loan data set	5
3.	**Data pre-processing** Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies	5
4.	**Data mining knowledge representation** Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge, Visualization techniques	4
5.	**Data Mining Algorithms: Association rules** Basic idea: item sets , Generating item sets and rules efficiently, Correlation analysis, Example: mining weather data	8
6.	**Data mining algorithms: Classification** Basic learning/mining tasks, Decision trees, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), **Data mining algorithms Clustering** Basic issues in clustering, First conceptual clustering system: Cluster/2, Partitioning methods: k-means, expectation maximization (EM), hierarchical methods: distance-based agglomerative and divisible clustering.	10

Text book and Reference books:

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.
4. Data Mining & Warehousing by Ikvinderpal Singh, Khanna Publishing House.
5. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
6. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.

.**Course Outcomes:**	
After completion of course, students would be:	
PEC-CSE 602B.1	Understand the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system
PEC-CSE 602B.2	Apply preprocessing methods for any given raw data.
PEC-CSE 602B.3	Analyse interesting patterns from large amounts of data
PEC-CSE 602B.4	Evaluate the accuracy of supervised and unsupervised models and algorithms.

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO2	3	2	2	2	-	-	-	2	-	-	-	-	2	2	-
CO3	3	2	2	-	2	-	-	1	1	-	-	-	1	1	-
CO4	-	-	2	2	-	-	-	-	1	-	-	-	-	1	-
AVG.	3	2.33	2	2	2	-	-	1.5	1	-	-	2	2	1.75	2

Pattern Recognition
Code: PEC-CSE 602C
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Study the fundamental algorithms for pattern recognition
2.	To instigate the various classification techniques
3.	To originate the various structural pattern recognition and feature extraction techniques.
Pre-Requisite:	
1.	Statistics and Probability Theory
2.	Differential Equations, ordinary and partial
3.	Analytical Geometry and Linear Algebra
4.	Differential and Integral Calculus

Unit	Content	Hrs.
1.	**Introduction:** Fundamental concepts and blocks of a typical pattern recognition system. Decision functions- role and types, pattern and weight space, properties and implementation of decision functions.	4
2.	**Feature identification, selection and extraction:** Distance measures, clustering transformation and feature ordering, clustering in feature selection, feature selection through maximization and approximations.	8
3.	**Pattern classification by distance functions:** Clusters and cluster seeking algorithms. Pattern classification by likelihood functions. Baye's classifier and performance measures.	8
4.	**Artificial Neural Network model**: Neural network-based pattern associators, Feed forward networks and training by back-propagation- ART networks.	8
5.	**Applications of Statistical and Neural network** – based pattern classifiers in speech recognition, image recognition and target recognition.	3
6.	**Miscellaneous Topics:** Hidden Markov Models (HMMs), Support Vector Machines (SVMs)	5

Text book and Reference books:

1. J.I. Tou & R.C. Gonzalez, Pattern Recognition Priciples, Addition-Wesley.

2. R. Schalkoff, Pattern Recognition - Statistiucal, Structural and Neural Approaches, John Wiley, 1992.
3. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.
4. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
5. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
6. Friedman and Kandel, Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches, World Scientific, 1999.

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 602C.1	Understand the various techniques involved in pattern recognition.
PEC-CSE 602C.2	Apply the various pattern recognition techniques into supervised and unsupervised learning applications.
PEC-CSE 602C.3	Analyse artificial neural network based pattern recognition tasks
PEC-CSE 602C.4	Evaluate the applications of pattern recognition in various applications

Numerical Methods
Code: OEC-CSE 601A
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand and analyse errors.
2.	To apply interpolation techniques.
3.	To perform numerical integration.
4.	To solve systems of linear equations
5.	To solve algebraic and differential equations numerically

Pre-Requisite:	
1.	Basic knowledge of differentiation, integration, matrix, and ordinary differential equation.

Unit	Content	Hrs.
1.	**Error and interpolation:** Truncation and rounding errors, Fixed and floating point arithmetic, Propagation of errors, Different operators and their relations, Newton forward, Newton's backward, Lagrange's and Newton's divided difference Interpolation formula.	12
2.	**Numerical integration:** Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms, Weddle's rule.	5

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	-	-	-	-	-	1	2	-
CO2	2	3	-	-	2	-	-	-	-	-	-	-	2	2	-
CO3	2	-	3	-	2	-	-	-	-	-	-	-	1	2	-
CO4	-	3	-	2	2	-	-	-	-	-	-	-	1	2	-
AVG.	2.33	3	2.5	2	2	-	-	-	-	-	-	-	1.25	2	-

Unit	Content	Hrs.
3.	**Numerical solution of a system of linear equations:** Gauss elimination method, Matrix inversion method, LU Factorization method, Gauss-Seidel iterative method.	8
4.	**Numerical solution of Algebraic equation:** Bisection method, Regula-Falsi method, Newton-Raphson method.	3
5.	**Numerical solution of ordinary differential equation:** Euler's method, Runge-Kutta methods, Predictor Corrector methods and Finite Difference method.	5

Text book and Reference books:

1. R.S. Salaria: Computer Oriented Numerical Methods, Khanna Publishing House
2. Sahajahan Ali Mollah: Numerical Analysis and Computational Procedures
3. Dutta & Jana: Introductory Numerical Analysis.
4. J.B.Scarborough: Numerical Mathematical Analysis.
5. Jain, Iyengar& Jain: Numerical Methods (Problems and Solution).
6. Balagurusamy: Numerical Methods, Scitech.
7. Baburam: Numerical Methods, Pearson Education.
8. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

Course Outcomes:	
After completion of the course, the students will be able to	
OEC-CSE 601A.1	Recall the basic concept related to polynomials, calculus, equations, system of linear equations and differential equations.
OEC-CSE 601A.2	Understand the concept of utilization of numerical methods for solving different complex mathematical problems
OEC-CSE 601A.3	Apply different numerical techniques to find the solution of different problems necessary for engineering practice by enhancing the power of knowledge.
OEC-CSE 601A.4	Analyze different real time problems and categorize them during the process of solving, by numerical technique.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	-	2	2	3	3	2
CO2	3	3	2	3	2	-	-	-	-	-	2	3	3	3	2
CO3	3	3	2	3	2	-	-	-	-	-	2	3	3	3	3
CO4	3	3	2	3	2	-	-	-	-	-	2	2	3	3	2
AVG.	3	3.00	2.00	3.00	2.00	-	-	-	-	-	2.00	2.50	3.00	3.00	2.25

Human Resource Development and Organizational Behaviour

Code: OEC-CSE 601B
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To aid students in understanding human behavior in organizations**,**
2.	To provide students with a comprehensive exposure to organizational behaviour theories, research and workplace issues.
3.	To recognize and discuss the different perspectives of working culture in organizations.
4.	To provide an overview of the theories and practices of management in organizational contexts.

Unit.	Content	Hrs.
1.	**[Organizational Behaviour: Introduction]** Importance, Challenges for OB, Organizational Culture.	2
2.	**[Personality and Attitudes, Perception]** Personality Determinants and Traits, Development of Personality, Types of Attitudes Importance, Factors influencing Perception, Link between Perception and Decision Making.	6
3.	**[Motivation]** 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.	8
4.	**[Group Behaviour]** Characteristics of Group, Stages of Group Development, Group Decision Making.	
5.	**[Communication]** Communication Process, Direction of Communication, Barriers to Effective Communication.	
6.	**[Leadership]** Importance, Theories of Leadership Styles.	4
7.	**[Conflict Management]** Functional and Dysfunctional Conflict, Conflict Process, Negotiation Process.	4

Text book and Reference books:

1. Organizational Behaviour – Robbins, S.P., Judge, T.A. & Vohra, N., Pearson
2. A textbook of Organizational Behaviour – Prasad, L.M. Sultan Chand & Sons.
3. Management and Organizational Behaviour – Mullins, L.J. & Christy, G., Pearson
4. Organizational Behaviour – McShane, S.L., Glinow, M.A.V. & Rai, H., McGraw Hill
5. Organizational Behavior – Luthans, F. McGraw Hill

Course Outcomes:	
On completion of the course students will be able to	
OEC-CSE 601B.1	Analyzing and appreciating the role of individual factors upon decision making in organizations and understanding the effect of motivation in achieving organizational excellence.
OEC-CSE 601B.2	Appraising guidelines for applying proper leadership styles on different contexts and analyzing the importance of various types of organization communication as a part of managerial skill development.
OEC-CSE 601B.3	Providing conflict resolution strategies for smooth functioning at group level as well as organizational level.
OEC-CSE 601B.4	Discussing the effect of organizational culture in developing satisfied and self-motivated internal stakeholders.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	2	-	3	3	2	1	3	1	3	3
CO2	-	1	-	-	-	1	-	3	3	3	1	3	2	3	3
CO3	1	-	-	-	-	1	-	2	3	2	1	1	1	2	3
CO4	-	-	-	1	-	1	1	3	3	2	2	1	1	3	3
AVG.	1	1	-	1	-	1.25	1	2.75	3	2.25	1.25	2	1.25	2.75	3

Soft Skill & Interpersonal Communication
Code: OEC-CSE 601C
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To improve the communication skills to enrich personality development, Computing skills of the students.
2.	To enhance the employability of the students. The courses will help to bridge the gap between the skill requirements of the employer or industry and the competency of the students.

Pre-Requisite:	
1.	Basic knowledge in communication and a good understanding of English

Unit	Content	Hrs.
1.	Communication Skills: Effective Communication, Barriers To Communication, Nonverbal Communication and its types, Listening Skills: Significance of Listening, Active Listening, Barriers To Active Listening, Telephone Communication and its Etiquettes.	9
2.	Technology And Communication: Technological Personality, Mobile Personality, Presentation Skills: The Role Of Body Language, Use of Audio and Visual Aids. Professional Etiquette, Netiquettes, E-mail Etiquette	8
3.	Planning And Goal-Setting, Human Perceptions: Understanding People, Types of Soft Skills, Self-Management Skills, Aiming For Excellence: Developing Potential And Self-actualization, Need Achievement And Emotional Intelligence.	7
4.	Conflict Management: What is conflict? Types of Conflicts, Conflict Resolution and Negotiation Skills.	6
5.	Habits: Guiding Principles ,Identifying Good And Bad Habits, Habit Cycle, Breaking Bad Habits ,Using The Zeigarnik Effect For Productivity And Personal Growth, Forming Habits Of Success.	6

Text Books And Reference:

1. Kukreja, Bharti. & Jain, Anupama. Effective Technical Communication. New Delhi: S.K. Kataria & Sons,2019.
2. S Dorch, Patricia. What Are Soft Skills? Execu Dress Publisher,2013.
3. Kamin ,Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Pfeiffer & Company, 2013.

4. Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. HarperCollins E-books, 2007.
5. Petes S.J., Francis. Soft Skills and Professional Communication. Tata McGraw-Hill Education, 2011.
6. Stein, Steven J.& Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Wiley & Sons, 2006.
7. Rizvi, M Ashraf. Effective Technical Communication. McGraw-Hill Education, 2005.

Course Outcomes:	
After completion of course, students would be able to:	
OEC-CSE 601C.1	Remember and recognize the fundamentals of different soft skills and interpersonal communication.
OEC-CSE 601C.2	Develop productive habits for success and personal growth and demonstrate skills relating to conflict management and goal setting strategies.
OEC-CSE 601C.3	Make use of diverse technical communication tools and etiquettes.
OEC-CSE 601C.4	Analyze various situations to mitigate different industrial communication needs.

Mapping of Cos with Pos and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	-	-	2	2	3	3	3	3	2	2	1	1
CO2	1	2	-	2	-	2	2	3	3	3	3	3	3	3	2
CO3	2	2	3	3	3	2	3	1	2	2	3	2	3	3	1
CO4	1	1	3	2	2	3	3	2	3	3	3	2	3	3	3
AVG.	1.33	1.5	3	2.33	2.5	2.25	2.5	2.25	2.75	2.75	3	2.25	2.75	2.5	1.75

Cloud computing lab
Code: PCC-CSE 691
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	Understand the fundamentals of cloud computing, including key concepts, architectures, deployment models, and service models.
2.	Gain hands-on experience with virtualization technologies and manage virtual environments effectively.
3.	Deploy and manage cloud-based applications using various platforms, including Google App Engine and OpenStack.
4.	Implement and simulate cloud resource management and big data processing using CloudSim and Hadoop.

Pre-Requisite:	
1.	Distributed computing, Computer Networks, knowledge of programming languages

Unit	Content	Hrs.
1.	**Introduction to Virtualization and Development Environment**	

	• **Install VirtualBox/VMware Workstation:** Set up VirtualBox or VMware Workstation on Windows, Install different flavours of Linux (e.g., Ubuntu) or Windows OS as virtual machines. • **Install and Use a C Compiler:** Install a C compiler (e.g., GCC) in the virtual machine, Compile and execute simple C programs.	
2.	**Cloud Application Deployment** • **Google App Engine (GAE) Setup:** Install Google Cloud SDK and set up Google App Engine, Create and deploy a basic "Hello World" application using Python or Java. • **Using GAE Launcher:** Use the GAE Launcher to deploy and manage web applications.	
3.	**Cloud Simulation and Resource Management** • **CloudSim Simulation:** Install and configure CloudSim for cloud resource simulation, Create and run a simulation scenario, including implementing and testing a custom scheduling algorithm. • **File Transfer Between VMs:** Find and apply procedures for transferring files between virtual machines, Demonstrate file transfer using tools like SCP or shared folders.	
4.	**OpenStack and Big Data Processing** • **Using TryStack for OpenStack:** Access TryStack (online OpenStack demo) and launch virtual machines. Perform basic VM management tasks such as starting, stopping, and configuring VMs. • **Hadoop Single Node Cluster:** Install and configure a single-node Hadoop cluster. Run basic MapReduce jobs (e.g., WordCount) and analyze results.	

List of Experiments:

1. Install VirtualBox/VMware Workstation with Linux or Windows OS
   - Objective: Set up and configure virtual machines.
   - Tasks: Install VirtualBox/VMware, create virtual machines, and configure networking.
2. Install a C Compiler in the Virtual Machine and Execute Simple Programs
   - Objective: Set up a development environment in a VM.
   - Tasks: Install GCC/MinGW, write, compile, and run simple C programs.
3. Install Google App Engine and Create a Hello World App Using Python/Java
   - Objective: Deploy a basic application on Google App Engine.
   - Tasks: Install Google Cloud SDK, set up a GAE project, and deploy a simple application.
4. Use GAE Launcher to Launch and Manage Web Applications
   - Objective: Manage web applications using GAE Launcher.
   - Tasks: Deploy, test, and debug applications on GAE.
5. Simulate a Cloud Scenario Using CloudSim
   - Objective: Understand cloud resource management and scheduling.

- Tasks: Install CloudSim, create simulation scenarios, and test custom scheduling algorithms.

6. Find Procedure to Transfer Files Between Virtual Machines
   - Objective: Learn file transfer techniques.
   - Tasks: Transfer files between VMs using SCP or shared folders.
7. Find Procedure to Launch Virtual Machines Using TryStack (OpenStack Demo)
   - Objective: Use OpenStack for VM management.
   - Tasks: Access TryStack, launch VMs, and perform basic management tasks.
8. Install Hadoop Single Node Cluster and Run Simple Applications Like WordCount
   - Objective: Set up Hadoop and execute MapReduce jobs.
   - Tasks: Install Hadoop, configure a single-node cluster, and run basic MapReduce jobs.
9. Host a Website Using GitHub Pages, Netlify, or Render
   - Objective: Deploy and manage a website on a cloud platform.
   - Tasks: Create and host a static website using GitHub Pages, Netlify, or Render; configure domain and deployment settings.
10. Explore AWS Cloud Services ***
    - Objective: Gain familiarity with AWS cloud services.
    - Tasks: Create an AWS account, explore AWS Management Console, and perform basic tasks such as launching EC2 instances and using S3 for storage.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcome:	
On completion of the course students will be able	
PCC-CSE 691.1	Demonstrate a comprehensive understanding of cloud computing fundamentals, including cloud architecture, deployment, and service models.
PCC- CSE 691.2	Set up and manage virtual machines using virtualization tools like VirtualBox and VMware, and effectively manage development environments within these VMs.
PCC- CSE 691.3	Deploy and manage web applications using cloud platforms such as Google App Engine and OpenStack, and handle file transfers and networking within virtual environments.
PCC- CSE 691.4	Gain practical insights into cloud resource management and data processing.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	2	1	3	1	2	1	3	2	2
CO2	3	2	3	2	3	1	2	1	2	2	2	2	3	3	3
CO3	3	2	2	3	3	1	2	1	2	1	2	1	3	2	2
CO4	3	2	3	1	3	1	2	1	2	1	2	1	3	3	2
AVG.	3	2	2.5	1.75	3	1	2	1	2.25	1.25	2	1.25	3	2.5	2.25

Computer Networks Lab
Code: PCC-CSE 692
Contacts: 4P
Practical: 4 hrs. / Week
Credit Points: 2

Course Objective:	
1.	To understand the working principle of communication system and various communication protocols.
2.	To analyze the various routing algorithms.
3.	To know the concept of data transfer between nodes.

Pre-Requisite:	
1.	Basic knowledge of C programming
2.	Basic understanding of computer algorithms

Laboratory Experiments:		**Hrs.**
1.	Familiarization with • Networking cables (CAT5, UTP) • Connectors (RJ45, T-connector) • Hubs, Switches Understanding IP address, subnet etc.	4
2.	Implement Interprocess communication using Message Queue.	4
3.	Design TCP client and server applications using socket programming.	4
4.	Design UDP client and server applications using socket programming.	4
5.	Implement the flow control protocols i.e., Stop and wait, Go back-N, selective repeat ARQ protocols.	8
6.	Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands (using CISCO Packet Tracer).	8
7.	Configuration of IP addressing for a given scenario for a given set of topologies (using CISCO Packet Tracer).	4
8.	Implement cryptographic algorithms RSA and DES for performing encryption and decryption.	4

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Text book and Reference books:

1. Unix Network Programming, Volume 1: The Sockets Networking API, 3rd Edition (2003), by W. Richard Stevens et al.
2. UNIX Network Programming, W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Third Edition, Pearson Education,2015.
3. UNIX Systems Programming using C++, T Chan, First Edition, Pearson, 2015.
4. W. Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols, Addison-Wesley, 1994.
5. CCNA Command Quick Reference (Cisco Networking Academy Program) By Scott D. Empson Published Apr 7, 2005 by Cisco Press.
6. Cryptography and Network Security – by Atul Kahate – TMH.
7. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
8. Behrouz A. Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.

Mapping of COs with POs and PSOs (Course Articulation Matrix):															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	2	2	-	2	2	2	-
CO2	2	3	2	2	2	-	-	-	2	-	-	2	2	2	-
CO3	2	2	3	2	3	-	-	-	2	-	-	2	2	3	3
CO4	2	2	-	2	-	-	-	-	-	-	-	2	-	-	-
AVG.	2.25	2.5	2.33	2	2.33	-	-	-	2	2	-	2	2	2.33	3

Course Outcomes:	
On completion of the course students will be able to	
PCC-CSE 692.1	Understand the use of various networking components as well as transmission media and cables for establishing a network.
PCC-CSE 692.2	Apply any topology using network devices.
PCC-CSE 692.3	Analyze performance of various communication protocols.
PCC-CSE 692.4	Evaluate various routing algorithms.

CSE
Fourth Year - Seventh Semester

Quantum Computing
Code: PEC-CSE 701A
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To introduce the fundamentals of quantum computing
2.	To learn about the operators involved in Quantum computing and their applications
3.	To comprehend the applications of quantum computing to information theory

Pre-Requisite:	
1.	Linear Algebra, Theory of Computation

Unit	Content	Hrs.
1.	Introduction to quantum computing, Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.	5
2.	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators.	10
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition & singular values, Postulates of Quantum Mechanics.	5
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	8
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, and Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures. Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	8

Text books:

1. Nielsen, M., & Chuang, I. In Quantum Computation and Quantum Information: 10th Anniversary Edition, Cambridge: Cambridge University Press.
2. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, Prometheus Books.
3. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson.

Reference books:

1. Quantum Computing without Magic by Zdzislaw Meglicki
2. Quantum Computing Explained By DAVID Mc MAHON
3. Quantum Computer Science by Marco Lanzagorta, Jeffrey Uhlmann
4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 701A.1	Understand basics of quantum computing and of Qubit.
PEC-CSE 701A.2	Apply operators of quantum computing in different applications.
PEC-CSE 701A.3	Remember the notions of Tensor Products and Density Operators.
PEC-CSE 701A.4	Evaluate the Quantum Measurements Theories.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	2	2	-	2	3	2	3
CO2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	-	1	2	-	2	-	2	-	2	3	3
CO4	3	3	3	3	2	2	-	2	2	1	2	2	3	3	3
AVG.	3.00	3.00	3.00	2.5	2.33	1.75	2.33	2.33	2.25	2.00	2.33	2.33	2.75	2.75	3.00

Software Engineering
Code: PEC-CSE 701B
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	This course introduces the concepts and methods required for the construction of large software intensive systems. It aims to develop a broad understanding of the discipline of software engineering.
2.	It seeks to complement this with a detailed knowledge of techniques for the analysis and design of complex software intensive systems. It aims to set these techniques in an appropriate engineering and management context.

Pre-Requisite:	
1.	C Programming, Java or C++ programming

Unit	Content	Hrs.
1.	The role of software, Overview of System Analysis & Design, SDLC, Waterfall Model , Iterative Model, Incremental Model, Evolutionary Model, Spiral Model, Agile Methodology, Case Study on SDLC models, Feasibility Analysis, Requirement Specification, Standard SRS Document.	9

Unit	Content	Hrs.
2.	System Design – Context diagram and DFD, Problem Partitioning, Top Down And Bottom Up design; Decision tree, Decision table, Functional vs. Object- Oriented design approach.	5
3.	Static and dynamic models, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram and implementation diagram.	6
4.	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing – Testing Objectives, Unit Testing, Integration Testing, System Testing, Types of System Testing , Software Testing Strategies: Test Drivers and Test Stubs, Structural Testing and Functional Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	9
5.	Software Project Management – Project Scheduling, Staffing, Cost Benefit Analysis, COCOMO model, Software Configuration Management, Quality Assurance, Project Monitoring, Risk Management, Project Maintenance, Preparation of Risk mitigation plan.	7

Text book and Reference books:

1. Pressman, Software Engineering: A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. Rajib Mall, Software Engineering- (PHI)
4. N.S. Gill, Software Engineering – (Khanna Publishing House)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

Course Outcomes:	
On completion of the course students will be able to	
PEC-CSE 701B.1	Understanding the principles of software engineering and analyzing various software development life cycle process.
PEC-CSE 701B.2	Creating various components of software using professional software design concepts.
PEC-CSE 701B.3	Understanding software testing and maintenance approaches following standard coding and testing guidelines.
PEC-CSE 701B.4	Evaluating software matrices and applying project management techniques to maximize the productivity.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	2	2	3	3	3	3	3	3	3	3
CO2	3	3	3	2	3	-	-	1	2	3	3	2	3	2	2
CO3	3	3	2	2	3	-	-	1	3	2	2	2	3	2	2
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
AVG.	**3**	**2.75**	**2.5**	**2.33**	**2.75**	**2**	**2**	**2**	**2.75**	**2.75**	**2.75**	**2.5**	**3**	**2.5**	**2.5**

Neural Networks and Deep Learning
Code: PEC-CSE 701C
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Understanding Human learning aspects.
2.	Acquaintance with primitives in the learning process by computer.
3.	Understanding the nature of problems solved with Deep Learning.

Pre-Requisite:	
1.	Statistics, Linear Algebra, Probability.

Unit	Content	Hrs.
1.	**Introduction**: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3
2.	**Feed forward neural network**: Artificial Neural Network, activation function, multi-layer neural network, cardinality, operations, and properties of fuzzy relations.	6
3.	**Training Neural Network**: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	6
4.	**Conditional Random Fields**: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9
5.	**Deep Learning**: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6
6.	**Deep Learning research**: Object recognition, sparse coding, computer vision, natural language.	6

Text book and Reference books:

1. Goodfellow I, BengioY., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6. Dr. Rajiv Chopra, Deep Learning, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 701C.1	Understand basic concepts of artificial neural networks in deep learning and functioning of the most common types of deep neural networks.
PEC-CSE 701C.2	To analyze model performance and results.
PEC-CSE 701C.3	To evaluate how to solve practical problems via artificial neural networks and deep learning techniques.
PEC-CSE 701C.4	To create Artificial Neural Networks and Deep Neural Networks in solving complex real-world problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	2	2	2	2
CO2	3	3	2	3	3	2	1	2	2	2	-	2	2	3	3
CO3	3	3	3	3	3	1	1	2	2	2	1	3	3	3	3
CO4	3	3	3	3	3	2	2	-	3	3	2	3	3	3	3
AVG.	3	3	2.5	2.75	2.75	1.5	1.33	2	2.33	2.33	1.5	2.5	2.5	2.75	2.75

Soft Computing
Code: PEC-CSE 701D
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Motivation and historical background of Soft Computing.
2.	Application of Fuzzy logic.
3.	Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization.
4.	Hybrid systems of neural network, genetic algorithms and fuzzy systems.

Unit	Content	Hrs.
1.	**Introduction**: Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm	8
2.	**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. **Applications of Fuzzy Logic**: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting.	10
3.	**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. Neuo-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification	8
4.	**Genetic Algorithms**: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA).	8

	Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition	
5.	**PSO**: Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	4

Text book and Reference books:

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
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

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 701D.1	Learn soft computing techniques and their applications.
PEC-CSE 701D.2	Analyse various neural network architectures.
PEC-CSE 701D.3	Define the fuzzy systems.
PEC-CSE 701D.4	Understand the genetic algorithm concepts and their applications.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	1	2	1	1	1	2	2	2	2
CO2	2	2	2	2	2	-	2	-	2	2	2	2	3	2	3
CO3	2	2	2	2	2	-	2	-	2	2	2	2	2	2	3
CO4	2	2	3	3	2	-	2	-	2	2	2	2	2	2	3
AVG.	1.75	2.00	2.00	2.25	1.75	1	1.75	2	1.75	1.75	1.75	2.00	2.25	2.00	2.75

Signals and Networks
Code: PEC-CSE 702A
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand the fundamental characteristics of signals and systems.
2.	To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.

Unit	Content	Hrs.
1.	Objective and overview, signal and system types and classifications, step response, impulse response and convolution integral.	3
2.	Periodic signal analysis: Fourier series and properties; Aperiodic signal analysis: Fourier Transform - its properties and sinusoidal steady state analysis of systems.	7

3.	Elements of electrical network : dependent and independent sources, active and passive components; classical differential equations for description of transient conditions of Network; Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient solutions of networks using Laplace Transform; Network functions: poles, zeros, transfer function, Bode plot.	10
4.	One and two port network parameters and functions: Z, Y and ABCD parameters, driving point and transfer impedances and admittances; Network Theorems and Formulation of Network equations: generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and Reciprocity Theorems.	10
5.	Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network; Analog filter design: Butterworth, Sallen Key, frequency transformation and scaling	6

Text book and Reference books:

1. Signals and Systems by P. Ramesh Babu& R. Ananda Natarajan, Scitech Publications (India).
2. Signals & Systems by A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Prentice-Hall India.
3. Networks & Systems by D Roy Choudhury.
4. Networks & Systems by Asfhaq Husain.

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 702A.1	Understand the objective and overview and fundamental characteristics of signal and system networks,
PEC-CSE 702A.2	Apply the concepts of Periodic signal analysis with Fourier series and properties.
PEC-CSE 702A.3	Analyze One and two port network parameters and functions.
PEC-CSE 702A.4	Creating mathematical skills to solve problems.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	P011	P012	PS01	PS02	PS03
CO1	3	-	2	2	2	2	1	-	-	-	2	1	2	-	2
CO2	3	-	2	2	-	2	1	-	-	-	2	-	2	-	-
CO3	-	1	-	2	2	3	2	-	-	-	3	3	3	2	-
CO4	3	-	2	2	2	2	1	-	-	-	2	-	-	2	-
AVG.	3	1.00	2	2.00	2	2.25	1.25	-	-	-	2.25	2	2.33	2	2

Cryptography and Network Security
Code: PEC-CSE 702B

Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand basics of Cryptography and Network Security.
2.	To be able to secure a message over insecure channel by various means.
3.	To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4.	To understand various protocols for network security to protect against the threats in the networks.

Pre-Requisite:	
1.	Computer Network and Telecommunication.

Unit	Content	Hrs.
1.	Attacks on Computers & Computer Security - Introduction, Need for Security, Security approaches, Principles of Security, Types of attack. Cryptography: Concepts & Techniques Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, and Symmetric & Asymmetric key Cryptography, Key Range & Key Size.	**10**
2.	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES (Data Encryption Standard) algorithm. Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	**10**
3.	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, and Certificate based Authentication, Biometric Authentication.	**8**
4.	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME. Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	**8**

Text book and Reference books:

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Cryptography and Network Security" by V.K. Jain, Khanna Publishing House,
3. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
4. Cryptography & Network Security: AtulKahate, TMH.

Reference Books

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 702B.1	**Understand** the basic concepts of data and system level security.
PEC-CSE 702B.2	**Illustrate** various Public key and private key cryptographic techniques
PEC-CSE 702B.3	**Evaluate** the authentication and hash algorithms.
PEC-CSE 702B.4	**Summarize** the intrusion detection and its solutions to overcome the attacks.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	3	-	2	-	-	-	-	2	2	3	2

CO2	3	3	-	3	2	-	-	-	-	-	2	-	3	3	2
CO3	3	3	-	3	2	-	2	-	-	-	-	-	3	3	2
CO4	3	2	3	2	-	-	2	-	-	-	-	-	3	2	1
AVG.	3.00	2.75	3.00	2.67	2.33	-	2.00	-	-	-	2.00	2.00	2.75	2.75	1.75

Speech and Natural Language Processing
Code: PEC-CSE 702C
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
2.	To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.
3.	To familiarize various NLP software libraries and data sets publicly available.
4.	To develop systems for various NLP problems with moderate complexity.
5.	To learn various strategies for NLP system evaluation and error analysis.

Pre-Requisite:	
1.	Concepts of Automata Theory.

Unit	Content	Hrs.
1.	NLP – introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English .	6
2.	Language Modelling with N-gram, Simple N-gram models, Smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development	7
3.	Parts-of-speech Tagging: basic concepts; Tagset; Early approaches: Rule based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model.	7
4.	Basic concepts: top down and bottom up parsing, treebank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.	8
5.	Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW; Concept of Word Sense; Introduction to WordNet	8

Text book and Reference books:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.
4. Jurafsky Dan and Martin James H. “Speech and Language Processing” ,3rd Edition, 2018.
5. Jurafsky D. and Martin J. H., “Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
6. Goldberg Yoav “A Primer on Neural Network Models for Natural Language Processing”.

Course Outcome:	
On completion of the course students will be able to	
PEC-CSE 702C.1	Understand the fundamental concepts and techniques of natural language processing (NLP).
PEC-CSE 702C.2	Applying the different approaches to discourse, generation, dialogue and summarization within NLP
PEC-CSE 702C.3	Evaluating current methods for statistical approaches to machine translation.
PEC-CSE 702C.4	Creating the computational properties of natural languages and the commonly used algorithms for processing linguistic information

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	1	1	1	-	-	-	1	1	1	-
CO2	2	2	1	2	1	-	1	-	1	2	-	1	1	3	2
CO3	2	2	2	2	2	1	1	1	2	-	1	2	2	1	1
CO4	2	1	2	2	2	2	-	-	-	3	2	2	1	1	1
AVG	1.75	1.5	1.67	2	1.67	1.33	1	1	1.5	2.5	1.5	1.5	1.25	1.5	1.33

Internet of Things
Code: PEC-CSE 702D
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Able to understand the basic concept of IoT & IoT enabled technologies.
2.	Able to realize the revolution of Internet in various Things (Devices), Cloud & Sensor Networks.
3.	Able to understand building blocks of Internet of Things and characteristics.
4.	Able to develop mini project with IoT enabled devices and technologies with data handling techniques.

Pre-Requisite:	
1.	Computer network, Wireless Networks, SQL

Unit	Content	Hrs.
1.	**INTRODUCTION TO IOT**: Introduction to IoT, History of IoT, About Things in IoT , Characteristics of IoT, Architectures of IoT, Physical design of IoT, Logical design of IoT, Communication models & APIs ,IoT & M2M Machine to Machine, Difference between IoT and M2M, Software define Network, Challenges in IoT(Design ,Development, Security), Enabling Technologies in IoT (Wireless Sensor Networks, Cloud Computing, Embedded Systems)	4
2.	**SENSORS**: Definition, Types of Sensors (Light sensor, temperature sensor, voltage sensor, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound Sensor), Types of Actuators. **IoT DEVELOPMENT BOARDS:** Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components,	8

	WORKING PROGRAMMING: Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins	
3.	**CONNECTIVITY AND COMMUNICATION PROTOCOLS:** IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, BACnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols	10
4.	**DATA HANDLING & ANALYTICS:** Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, IoT data analytics overview, IoT data analytics challenges. **Machine Learning:** Machine Learning overview, Predictive analytics. Big data analytics tools and technology: Massively parallel processing databases, NoSQL databases, HADOOP.	8
5.	**APPLICATION OF IoT**: Home Automation, Smart Cities, Energy, Retail Management, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	6

Text Books

1. Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson and Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications
4. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
5. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. 4. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
6. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.

Course Outcomes:	
On completion of the course the student should be able to	
PEC-CSE 702D.1	To understand the fundamental concept of IOT and IoT enabled technologies with respect to sensors.
PEC-CSE 702D.2	To learn development boards with various components and high-level programming.
PEC-CSE 702D.3	To analyze various protocols and data handling techniques in IoT.
PEC-CSE 702D.4	To apply knowledge in various smart projects for society betterment maintaining values & ethics.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	2	2	1	-	1	1	3	3	1	1

CO2	3	2	3	1	3	2	3	2	2	1	1	3	3	2	2
CO3	3	2	3	3	3	2	1	-	2	2	2	3	3	3	3
CO4	3	3	3	3	3	3	2	3	2	2	3	3	3	3	3
AVG.	3.00	2.25	2.50	2.33	2.75	2.25	2.00	2.00	2.00	1.50	1.75	3.00	3.00	2.25	2.25

Industry Internship
Code: TR-CSE 771
Contact:
Credit Points: 3

Industry Internship

OBJECTIVES

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to **learn, understand and sharpen** the real time technical / managerial skills required at the job.
- **Exposure to the current technological developments** relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to **apply** the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- **Promote academic, professional and/or personal development**.
- Expose the students to future employers.
- **Understand the social, economic and administrative considerations** that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

INTERNSHIP GUIDELINES:

The T&P cell will arrange internship for students in industries/organization after second, fourth and six/seventh semester(s) or as per AICTE/ affiliating University guidelines. The general procedure for arranging internship is given below:

- **Step 1:** Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

- **Step 2:** Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.
- **Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.
- **Step 4:** Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)
- **Step 5:** Students will submit training report after completion of internship.
- **Step 6:** Training Certificate to be obtained from industry.
- **Step 7:** List of students who have completed their internship successfully will be issued by Training and Placement Cell.

Course Outcomes:	
On completion of the course students will be able to	
TR-CSE 771.1	To **construct** the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance as well as to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT), and demonstrate awareness of **documentation, and professional reporting requirements** toward promoting academic, professional and/or personal development for his / her organization of internship.
TR-CSE 771.2	To **determine** the technological/managerial challenges along with social and economic considerations for his / her internship organization, and evaluate industrial practices to develop **industry readiness.**
TR-CSE 771.3	To **test** the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period and to analyze the functioning of internship organization to recommend changes for organizational betterment as well as to enhance **professional competence, employability,** preparedness for **higher studies and research**.
TR-CSE 771.4	To **apply** various soft skills such as time management, positive attitude and communication skills along with prompt technical knowledge during performance of the tasks assigned in internship organization compliance with organizational **requirements**, and readiness for industrial careers and lifelong learning.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	2	2	3	3	3	3	3	3
CO4	-	-	2	-	2	2	-	-	-	-	-	-	-	-	2
AVG.	3	3.00	2.50	3.00	2.50	2.00	-	2.00	2.00	3.00	2.50	3.00	2.50	3.00	2.50

Project-I

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Code: PROJ- CSE 781
Contact: 12P
Credit Points: 6

Project Work I
Objective :The objective of Project Work I is to enable the student to take up investigative study in the broad field of Computer Science & Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include: 1. Survey and study of published literature/existing application on the assigned topic. 2. Working out a preliminary approach to the problem relating to the assigned topic. 3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/ Feasibility. 4. Preparing a written report on the study conducted for presentation to the department. 5. Final Seminar, Presentation before a departmental faculty panel. 6. The evaluation of the Project Work I will be done as per the procedure suggested by the department.

Course Outcome:	
On completion of the course students will be able to	
PROJ- CSE 781.1	Understanding the literature; Identify and classify the requirements for the solution of complex engineering problems.
PROJ- CSE 781.2	Applying proper solution, architecture, module level designs, algorithms by proper analysis and interpretation.
PROJ- CSE 781.3	Evaluating project metrics like size, effort and cost, reliability and quality, etc and plan project development schedule.
PROJ- CSE 781.4	Creating technical documentation, presentation, and discussions as a group to share knowledge to justify the work .

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	2	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	3	1	-	-	3	2	2
CO3	-	-	2	2	1	-	-	-	3	2	1	1	2	3	-
CO4	-	-	-	1	-	-	-	-	3	-	-	-	-	-	2
AVG.	3.00	3.00	2.00	1.67	1.00	-	-	-	2.75	1.50	1.00	1.00	2.67	2.50	2.00

CSE
Fourth Year - Eighth Semester
(Semester VIII)

Big Data Analysis
Code: OEC-CSE 801A
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Understand big data for business intelligence. Learn business case studies for big data analytics. Understand no sql big data management. Perform map-reduce analytics using Hadoop and related tools

Pre-Requisite:	
1.	Programming language to solve real world learning problems and extract knowledge from real datasets.

Unit	Content	Hrs.
1.	What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.	6
2.	Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	6
3.	Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures	8
4.	MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats	8
5.	Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin	7

	scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	

References:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
2. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi (2017).
3. V.K. Jain, Data Analysis, Khanna Publishing House, New Delhi (2019).
4. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
7. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
8. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
9. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
10. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
11. Alan Gates, "Programming Pig", O'Reilley, 2011.

Course Outcomes:	
After completion of course, students would be:	
OEC-CSE 801A.1	To understand the Big Data Platform and its Use cases.
OEC-CSE 801A.2	To analyse the overview of Apache Hadoop .
OEC-CSE 801A.3	To remember HDFS Concepts and its Interfacing with HDFS and big data management.
OEC-CSE 801A.4	To evaluate and learn business case studies for big data analytics and map -reduce analytics using Hadoop and related tools

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	2	1	1	3	2	3	1	3	2	1	1
CO2	3	3	3	2	3	1	2	1	3	2	2	2	3	2	3
CO3	2	2	2	3	3	-	2	-	3	1	3	3	2	1	2
CO4	2	3	3	3	3	1	3	1	3	1	2	1	3	3	3
AVG.	2.25	2.25	2.75	2.50	2.75	1	2.00	1.67	2.75	1.75	2.00	2.25	2.50	1.75	2.25

Cyber Law and Ethics
Code: OEC-CSE 801B
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To introduce the cyber world and cyber law in general.
2.	To explain about the various facets of cyber crimes.
3.	To enhance the understanding of problems arising out of online transactions and provoke them to find solutions.
4.	To clarify the Intellectual Property issues in the cyber space and the growth and development of the law in this regard.

Pre-Requisite:
N/A

Unit	Content	Hrs.
1.	**Introduction of Cybercrime:** What is cybercrime? Types of Cybercrime, Forgery,Hacking,Software Piracy, Computer Network intrusion. **Case Studies**: Real-world examples of significant cybercrimes. **History of Cybercrime**: Evolution and notable milestones. **Category Cybercrime:** of how criminals plan attacks, passive attack, Active attacks, cyberstalking.	8
2.	**Cybercrime Mobile & Wireless devices**: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop	8
3.	**Tools and Methods used in Cybercrime**: Proxy servers, pan word checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow, Advanced Persistent Threats (APTs), Ransomware.	7
4.	**Phishing & Identity Theft**: Phishing methods, ID Theft; Online identity method, Social Media Exploits, Email Security.	6
5.	**Cybercrime & Cybersecurity**: Legal aspects, Indian laws, IT act, Public key certificate, Incident Response and Management, Cyber Forensics, Ethical Hacking(Principles, methodologies, and certifications).	6

Text book and Reference books:

1. Cyber security by Nina Gobole&SunitBelapune; Pub: Wiley India.
2. Information Security & Cyber laws by Gupta & Gupta, Khanna Publishing House
3. Cybersecurity and Cyberwar: What Everyone Needs to Know by P.W. Singer and Allan Friedman
4. Computer Forensics and Cyber Crime: An Introduction by Marjie T. Britz
3. Cybercrime and Digital Forensics: An Introduction by Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar
4. Introduction to Cyber-Warfare: A Multidisciplinary Approach by Paulo Shakarian, Jana Shakarian, and Andrew Ruef
5. Ransomware: Defending Against Digital Extortion by Allan Liska and Timothy Gallo
6. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software by Michael Sikorski and Andrew Honig
7. Hacking Exposed: Network Security Secrets and Solutions by Stuart McClure, Joel Scambray, and George Kurtz

Course Outcomes:	
After completion of course, students would be:	
OEC-CSE 801B.1	Understand and Apply Foundational Concepts in Cyber Law and Ethics
OEC-CSE 801B.2	Analyze and Evaluate Legal and Ethical Issues in Information Technology
OEC-CSE 801B.3	Apply Web Security Principles and Forensic Tools.
OEC-CSE 801B.4	Create Comprehensive Security Plans and Solutions.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	3	-	-	-	-	-	-	2	3	2	1
CO2	-	-	-	-	-	3	-	3	-	1	-	-	2	1	-
CO3	3	3	3	3	3	-	-	-	-	1	-	2	3	3	2
CO4	3	3	3	3	3	1	2	3	2	3	3	3	3	3	3
AVG.	3.00	2.67	3.00	2.33	3.00	2.00	2.00	3.00	2.00	1.67	3.00	2.33	2.75	2.25	2.00

Mobile Computing
Code: OEC-CSE 801C
Contacts: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	To describe and analyse the network infrastructure requirements to support mobile devices and users.
2.	To illustrate the concepts, techniques, protocols and architecture employed in wireless local area networks, cellular networks, and perform basic requirements analysis
3.	To apply techniques and current network technologies to the consideration of next generation technologies

Pre-Requisite:	
1.	Understanding of computer networks.

Unit	Content	Hrs.
1.	**Wireless Networks and Mobile Systems:** Cellular Mobile Wireless Networks: Systems and Design Fundamentals, Propagation Models	5
2.	**Evolution of Modern Mobile Wireless Communication System** - First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Wireless Local Area Networks (WLANs), Cellular –WLAN Integration, All IP Network: Vision for 4G	5
3.	**Wireless Energy Management:** Measurement of energy consumption, WiFi Power Save Mode (PSM), Constant Awake Mode (CAM), Different Sleep States, WiFi Energy management	7
4.	**Localization:** User location and tracking system, Cell tower localization, Spot localization, Logical location, Ambience fingerprinting, War-driving,	7

	Localization without war-driving, Indoor localization, Crowd sourcing for localization.	
5.	**Context Sensing:** Context-Aware system, Automatic Image Tagging, Safety critical applications (case study: determining driver phone use), Energy-efficient Context Sensing, Contextual Ads and Mobile Apps	7
6.	**Mobility:** Overview of Mobility models, Automatic Transit Tracking, Mapping, Arrival Time Prediction, Augmenting Mobile 3G with WiFi, Vehicular WiFi Hotspots, Code Offload, Privacy and Security: Authentication on Mobile Phones, Activity based Password, Finger Taps usage as Fingerprints, Location Privacy	7

Text book and Reference books:

1. "Pervasive Computing", Burkhardt, Pearson
2. "Mobile Communication", J. Schiller, Pearson
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin &ImrichChlamtac, John Wiley & Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
6. Smart Phone and Next Generation Mobile Computing (Morgan Kaufmann Series in Networking), Pei Zheng, Lionel Ni

Course Outcomes:	
After completion of course, students would be:	
OEC-CSE 801C.1	Understand basic terminologies of mobile computing, fundamental concepts of mobile programming environment
OEC-CSE 801C.2	Apply the components and functioning of mobile networking to develop mobile applications
OEC-CSE 801C.3	Analyse the functioning of WLAN for local as well as remote applications.
OEC-CSE 801C.4	Evaluate the performance of mobile applications using the concepts of mobility management.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	2	-	-	-	-	-	-	3	3	2	1
CO3	3	1	2	2	2	-	-	-	-	-	-	3	2	2	1
CO4	2	2	2	2	3	1	-	-	-	1	1	3	2	3	2
AVG.	2.75	2.25	2.25	2	2.25	1	-	-	-	1	1	3	2.5	2.25	1.25

Ad-hoc and Sensor Network
Code: OEC-CSE 801D
Contact: 3L
Theory: 3 hrs. / Week
Credit Points: 3

Course Objective:	
1.	Provide an overview about sensor networks and emerging technologies
2.	To study about the node and network architecture of sensor nodes and its execution environment.
3.	To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN
4.	To learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control
5.	To study about sensor node hardware and software platforms and understand the simulation and programming techniques.
6.	These networks aim to facilitate seamless communication among distributed nodes in various application scenarios while addressing challenges such as limited resources, energy constraints, and dynamic environments.

Pre-Requisite:	
1.	Computer networking concepts.

Unit	Content	Hrs.
1.	**Introduction and Overview:** Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.	4
2.	**Architectures Single-node architecture -** hardware components, design constraints, energy consumption of sensor nodes, operating systems and execution environments, examples of sensor nodes, sensor network scenarios, types of sources and sinks – single hop vs. multi hop networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design principle.	8
3.	**Communication Protocols :**Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts - S-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols classification, gossiping, flooding, energy efficient routing, unicast protocols, multipath routing, data-centric routing, data aggregation, SPIN, LEACH, Directed Diffusion, geographic routing.	8
4.	**Infrastructure Establishment**: Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control	7
5.	**Sensor Network Platforms and Tools:** Sensor node hardware, Berkeley motes, programming challenges, node level software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.	8

Text books:

1. Carlos Corderio Dharma P.Aggarwal, "Ad Hoc and sensor networks", world scientific publication/
   Cambridge university press, March 2006
2. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
4. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
6. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

Course Outcome:	
On completion of the course students will be able to	
OEC-CSE 801D.1	Understanding the overview of the physical, networking and architectural issues of mobile ad-hoc networks.
OEC-CSE 801D.2	Apply routing algorithms such as AODV (Ad-hoc On-Demand Distance Vector) and DSR (Dynamic Source Routing) to route data in ad-hoc networks.
OEC-CSE 801D.3	Analyse the performance of different routing protocols under varying network conditions and traffic loads.
OEC-CSE 801D.4	Evaluate the energy efficiency and reliability of communication protocols in ad-hoc and sensor networks.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	3	2	-	-
CO2	2	3	-	3	-	-	-	-	-	-	-	3	2	3	2
CO3	2	1	-	2	2	-	-	-	-	-	-	3	2	3	1
CO4	2	-	-	-	-	1	1	-	-	-	-	2	2	1	-
AVG.	2.25	2.33	-	2.50	2.00	1.00	1.00	-	-	-	-	2.75	2.00	2.33	1.50

Industry Internship
Code: TR-CSE 871
Contact:
Credit Points: 3

Industry Internship

OBJECTIVES

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

INTERNSHIP GUIDELINES:

The T&P cell will arrange internship for students in industries/organization after second, fourth and six/seventh semester(s) or as per AICTE/ affiliating University guidelines. The general procedure for arranging internship is given below:

- **Step 1:** Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

- **Step 2:** Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

- **Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

- **Step 4:** Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)

- **Step 5:** Students will submit training report after completion of internship.

- **Step 6:** Training Certificate to be obtained from industry.

- **Step 7:** List of students who have completed their internship successfully will be issued by Training and Placement Cell.

Course Outcomes:	
On completion of the course students will be able to	
TR-CSE 871.1	To **construct** the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance as well as to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT), and demonstrate awareness of **documentation, and professional reporting requirements** toward promoting academic, professional and/or personal development for his / her organization of internship.
TR-CSE 871.2	To **determine** the technological/managerial challenges along with social and economic considerations for his / her internship organization, and evaluate industrial practices to develop **industry readiness.**
TR-CSE 871.3	To **test** the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period and to analyze the functioning of internship organization to recommend changes for organizational betterment as well as to enhance **professional competence, employability,** preparedness for **higher studies and research**.
TR-CSE 871.4	To **apply** various soft skills such as time management, positive attitude and communication skills along with prompt technical knowledge during performance of the tasks assigned in internship organization compliance with organizational **requirements**, and readiness for industrial careers and **lifelong learning**.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	2	2	3	3	3	3	3	3
CO4	-	-	2	-	2	2	-	-	-	-	-	-	-	-	2
AVG.	3	3.00	2.50	3.00	2.50	2.00	-	2.00	2.00	3.00	2.50	3.00	2.50	3.00	2.50

Project-II
Code: PROJ- CSE 881
Contact: 12P
Credit Points: 6

Project Work II & Dissertation
Objective :The objective of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under guidance, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include: 1. In depth study of the topic assigned in the light of the Report prepared under EC P1; 2. Review and finalization of the Approach to the Problem relating to the assigned topic; 3. Preparing an Action Plan for conducting the investigation, including team work; 4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed; 5. Final development of product/process, testing, results, conclusions and future directions; 6. Preparing a paper for Conference presentation/Publication in Journals, if possible; 7. Preparing a Dissertation in the standard format for being evaluated by the Department. 8. Final Seminar Presentation before a Departmental Committee.

Course Outcomes:	
After completion of course, students would be:	
PROJ- CSE 881.1	Applying the system design of project-I in to executable code(s) using modern programming languages to Build the system.
PROJ- CSE 881.2	Analysing the developed system tested & validate by following standards testing techniques.
PROJ- CSE 881.3	Evaluating project metrics like size, effort and cost, reliability and quality, etc and plan project development schedule..
PROJ- CSE 881.4	To determine all the system development phases towards the completion of the Project and analyse/compare the result(s); evaluate and maximize system performances which contribute to lifelong learning.

Mapping of COs with POs and PSOs (Course Articulation Matrix):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	2	-	-	-	3	1	-	-	1	1	1
CO2	3	1	3	1	3	-	-	2	3	-	1	-	1	3	2
CO3	3	-	3	1	-	-	-	-	3	3	1	1	-	-	3
CO4	3	-	3	1	2	2	1	3	3	3	1	1	-	2	3
AVG.	2.50	1.00	3.00	1.00	2.33	2.00	1.00	2.50	3	2.33	1.00	1.00	1.00	2.00	2.25