

Guru Nanak Dev Engineering College, Ludhiana
Computer Science & Engineering Department

Ref. No.: CSE/41/689

Dated: 19/09.2023

S.No.	Semester	Course	Course Code	Syllabus for MSE-1
1	3 rd	Object Oriented Programming	PCCS-101	<p>Object-Oriented Programming Concepts: Introduction, Comparison between procedural programming paradigm and object-oriented programming paradigm, Features of object-oriented programming: Encapsulation, Class, Object, Abstraction, Data hiding, polymorphism, and Inheritance. Introduction of object-oriented design.</p> <p>Data Types, Operators, and Control Structures: Basic data types, Derived data types, Keywords, Identifiers, Constants and variables, Type casting, Operators, and Operator precedence. Control Structures: if statement, switch-case, for, while and do-while loops, break and continue statement.</p> <p>Classes and Objects: Implementation of a class, creating class objects, Operations on objects, Relationship among objects, Accessing class members, Access specifiers, Constructor and destructor, Types of constructors, Static members, Empty classes, Nested classes, Local classes, Abstract classes, Container classes.</p> <p>Functions, Arrays, and String Handling: Function components, Default arguments, passing parameters, Function prototyping, call by value, call by reference, Return by reference, Inline functions, Friend functions, Static functions, Recursion, Array declaration, Types of arrays, Array of objects, String handling.</p>
2		Computer Networks	PCCS-102	<p>Data Communication Components: Representation of data and data flow, Various Network Topologies, Protocols and Standards, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing- Frequency division, Time division and Wave division, Concepts on spread spectrum, OSI model, TCP/IP reference model and their comparison.</p> <p>Physical Layer: Concept of analog and digital systems, Transmission Media, Transmission impairments and Data rate limits- Nyquist formula, Shannon formula, Switching- Circuit, Message and Packet switching.</p> <p>Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction, Fundamentals, Block coding, Hamming Distance, CRC;</p>
3		Digital Electronics	ESCS-101	<p>Number Systems:</p> <p>Binary, Octal, Decimal, Hexadecimal. Number base conversions, 1's, 2's, rth's complements, signed Binary</p>

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				<p>numbers. Binary Arithmetic, Binary codes: Weighted BCD, Gray code, Excess 3 code, ASCII – conversion from one code to another.</p> <p>Boolean Algebra: Boolean postulates and laws – De-Morgan’s Theorem, Principle of Duality, Boolean expression – Boolean function, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS), Minterm, Maxterm, Canonical forms, Conversion between canonical forms, Karnaugh map Minimization.</p> <p>Logic GATES: AND, OR, NOT, NAND, NOR, Exclusive-OR and Exclusive-NOR. Implementations of Logic Functions using gates, NAND-NOR implementations. Study of logic families like RTL, DTL, DCTL, TTL, MOS, CMOS, ECL and their characteristics.</p> <p>Combinational Circuits: Design procedure – Adders, Subtractors,</p>
4		Human Values and Professional Ethics	HSMCS-101	Part- A (complete)
5		Mathematics-III	BSCS-101	Unit-3, Unit-4, Unit-1, Unit-2 (upto Cauchy integral formula)
6	5 th	Artificial Intelligence	PCCS-108	<p>Introduction: Intelligence, Foundations of artificial intelligence (AI). History of AI, Agents and Environments, Rationality of Agents, Nature and Structure of Agents, Communication among Agents.</p> <p>Problem Formulation and solution: Problem types, States and operators, State space, Uninformed Search Strategies, Informed Search Strategies – Best first search, A* algorithm, Heuristic functions, Iterative deepening A*(IDA), Small memory A*(SMA).</p> <p>Game playing: Perfect Information game, Imperfect Information game, Evaluation function, Minimax algorithm, Alpha-beta pruning.</p>
7		Software Project Management	PECS-101	Introduction to Project Management: The characteristics of software projects. Objectives of project management: time, cost and quality, Basics of Project Management, Stakeholders, Stages of Project, The Feasibility Study, Cost-benefit Analysis, Planning, Project Execution, Project and

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				<p>Product Life Cycles, Project Management Knowledge areas, Project Management Tools & Techniques, Project success factors, role of project manager</p> <p>Project Evaluation and Planning: Activities in Software project management, Project evaluation-Cost benefit analysis, Cash flow forecasting, Cost benefit evaluation techniques, Risk evaluation.</p> <p>Project planning - Stepwise project planning, Software processes and process models. Project costing, COCOMO II, Staffing pattern, Effect of schedule compression</p>
8	Advanced Computer Networks	PECS-106	<p>Introduction: Basics, History of Internet, Requirements: perspectives, scalable connectivity, cost effective resource sharing, support for common services, manageability, network architecture: layering and protocols, Internet architecture, network performance: bandwidth, latency, high-speed networks, application performance needs.</p> <p>Internetworking: half and full duplex, Ethernet at physical layer: standard Ethernet, fast Ethernet, gigabit Ethernet, Ethernet cabling-straight-through, crossover and rolled cable, Data encapsulation. Ethernet at data link layer: CSMA, CSMA/CD and CSMA/CA.</p> <p>Wireless LANs: Introduction: architecture comparison, characteristics, access control. IEEE 802.11: architecture, MAC Sublayer, Physical layer. Bluetooth: architecture and its layers.</p>	
9	Statistics for Data Science	PECS-113	<p>PART A</p> <p>Random Variables and Probability Distributions: Random Variables, Discrete Probability Distributions, Distribution Functions for Random Variables, Distribution Functions for Discrete Random Variables, Continuous Random Variables, Joint Distributions, Independent Random Variables, Change of Variables, Probability Distributions of Functions of Random Variables, Convolutions, Conditional Distributions, Applications to Geometric Probability</p> <p>Special Probability Distributions- Binomial Distribution, Normal Distribution, Poisson Distribution, The Central Limit Theorem, Multinomial Distribution, Hyper geometric Distribution, Uniform Distribution, Cauchy Distribution, Gamma Distribution, Beta Distribution, The Chi-Square Distribution, Student's t</p>	

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				<p>Distribution, F Distribution, Relationships Among Chi-Square, t, and F Distributions, Bivariate Normal Distribution.</p> <p>Introduction to Statistics: Population and sample, parameters and statistics, Simple descriptive statistics - Mean, Median, Quantiles, percentiles, and quartiles, Variance and standard deviation, Standard errors of estimates, Interquartile range.</p>
10	Information Retrieval	PECS-116		<p>Introduction: History of IR, Components of IR, The IR Problem, The IR System, The Software Architecture of the IR System, The impact of the web on IR, The role of artificial intelligence (AI) in IR, IR Versus Web Search, Components of a Search engine.</p> <p>Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.</p> <p>Experimental Evaluation: Performance Metrics: Recall, Precision, F-measure, Evaluations on benchmark text collections</p> <p>Retrieval Utilities, Indexing, and Searching, Relevance Feedback, Clustering, Passage based Retrieval, N-Grams</p>
11	System Programming	PECS-125		<p>Overview of System Software, Language Processors, Introduction to Assembly Language Program</p>
12	Database Management Systems	PCCS-109		<p>Part A</p> <p>Introduction to Database Concepts: Introduction, Database systems versus file systems, Difference between Database and non database systems, Characteristics of database approach, Advantages and Disadvantages of using DBMS. Database users and administrators, Schemas and Instances, DBMS Architecture. components of a database system, Data Independence, Database Language and Interfaces, Classification of Database Management Systems. Introduction to NoSQL database.</p> <p>Entity Relationship Model: Data models, Entity types, Entity sets, Attributes and keys, Relationship types, Relationship sets, Roles and structural constraints, Weak entity types, Design choices for ER conceptual design, Comparison of Models.</p> <p>Relational Model: Relational Model concepts, Constraints, Update operations, Transaction and dealing with constraint violations. Relational Algebra-Unary relational operations, Operations from Set theory, Binary relational operations, DIVISION operation and additional relational operations. Relational Calculus “ Tuple</p>

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				<p>relational calculus and Domain relational calculus, Queries related to Relational Algebra and Relational Calculus.</p> <p>SQL: SQL Data Definition and data types, specifying constraints in SQL, Schema change statements, Basic queries in SQL, Set operations, Aggregate functions and views, Complex queries in SQL.</p>
13		Formal Language & Automata Theory	PCCS-110	<p>Finite Automata: Deterministic Finite Automata, Acceptance by Finite Automata, Transition systems, Non-Deterministic Finite Automata, Equivalence of DFA and NDFA, Moore and Mealy machines, Equivalence of Moore and Mealy machine, Minimization of Finite Automata, Applications and limitations of Finite Automata.</p> <p>Formal Languages: Basics of strings, Alphabets, grammar, Formal language, Chomsky classification of languages, Languages and their relation, Operations on languages, Closure properties of language classes.</p> <p>Regular Grammar: Regular grammars, Regular expressions, Algebraic method using Arden's theorem, Equivalence of Finite Automata and Regular expressions, Properties of regular languages, Pumping lemma.</p>
14		Design and Analysis of Algorithms	PCCS-111	<p>Introduction: Algorithms, Algorithm Specification, Performance Analysis: Space complexity, Time complexity, Asymptotic Notations- Big-Oh notation (O), Omega notation ($\hat{\omega}$), Theta notation ($\hat{\Theta}$), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples.</p> <p>Divide and Conquer: General method, solving recurrences using recurrence trees, repeated substitution, statement of Master Theorem, applications " Binary search, Merge sort, Quick sort, Strassen's Matrix Multiplication, Finding the maximum and minimum. [5 Hours]</p> <p>Greedy Algorithms: Greedy choice, optimal substructure property, minimum spanning trees-Prims and Kruskals, Dijkstra shortest path using arrays and heaps, fractional knapsack, Travelling salesperson problem and Huffman coding.</p> <p>Dynamic Programming: Introduction to dynamic programming and application of the algorithm to solve multistage graphs, edit distance, matrix chain</p>

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				multiplication, All pairs shortest path problem and Knapsack problem.
15		Organisational Behaviour	MCI-103	Unit 1
16		Constitution of India	MCI-102	Salient features of constitution, Federal structure , Preamble of constitution
17	7 th	Agile Software Development	PECS-103	<p>PART-A</p> <p>Introduction: Need of Agile software development, agile contextâ€“ Manifesto, Principles, Methods, Values, Roles, Artifacts, Stakeholders, and challenges. Business benefits of software agility.</p> <p>Project Planning: Recognizing the structure of an agile teamâ€“ Programmers, Managers, Customers. User storiesâ€“ Definition, Characteristics and content. Estimationâ€“ Planning poker, Prioritizing, and selecting user stories with the customer, projecting team velocity for releases and iterations.</p> <p>Project Design: Fundamentals, Design principlesâ€“Single responsibility, Open-closed, Liskov substitution, Dependency-inversion, Interface-segregation.</p>
18		Software Defined Networks	PECS-109	<p>Introduction: Historical Background of Software Defined Networking (SDN), The SDN Approach: Requirements, Characteristics of Software-Defined Networking, The Modern Data Center, Traditional Switch Architecture: Data Control and Management Planes, Centralized and Distributed Control and Data Planes.</p> <p>Software Defined Networking (SDN): The need of SDN, Fundamental Characteristics of SDN, SDN Operation, SDN Devices: Flow Tables, SDN software switches, hardware SDN devices, SDN Applications.</p> <p>Network Functions Virtualization: Background and motivation for NFV- Virtual Machines- NFV Concepts: Simple example of use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements-NFV Reference Architecture.</p> <p>SDN Controllers: SDN Controllers: Core modules, Its Interfaces, implementations, Alternative SDN Methods: SDN via APIs, SDN via Hypervisor Based Overlays.</p>
19		Data Warehouse and Data Mining	PECS-115	<p>Introduction to Data Warehousing and Data Mining: Historical developments in data warehousing, Defining data warehousing, Data warehouse architecture, Benefits of data warehousing, Data Granularity, The Information Flow Mechanism, Metadata, Two Classes of Data, The Lifecycle</p>

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				<p>of Data, Data Flow from Warehouse to Operational Systems, Data Warehouse v/s Data Mining, Data Mining Applications, Data Mining Process, Data Mining Techniques, Predictive modelling, Database segmentation, Link analysis, Deviation detection, Difference between Data Mining and Machine Learning.</p> <p>The Building Blocks of a Data Warehouse: Data Warehouse: The Need for an Operational Data Store (ODS), Operational Data Store, Data Marts: Comparative Study of Data Warehouse with OLTP and ODS, Data Warehouse Schema, Introduction to Data Warehouse Schema: Dimension, Measure, Fact Table, Multi-dimensional view of data, Star Schema, Snowflake Schema, Fact Constellation Schema (Galaxy Schema), Comparison among Star, Snowflake and Fact Constellation Schema.</p> <p>Online Analytical Processing: Introduction to Online Analytical Processing, Defining OLAP, OLAP applications, Features of OLAP, OLAP Benefits, Strengths of OLAP, Comparison between OLTP and OLAP, Differences between OLAP and data mining.</p>
20	Computer Vision	PECS-121	Digital image formation and low-level processing, visual features and representations (edge detection)	
21	Advanced Algorithm Design and Analysis	PECS-127	PART A	
22	Object Oriented Design using UML	PECS-104	<p>Introduction: Introduction to Object Oriented Development, Introduction to Object Oriented analysis and design with fundamentals, Various Principles of modeling, Need of Object-Oriented analysis and design.</p> <p>System and Process: Introduction to SDLC, Iterative and evolutionary analysis and design, Agile modeling, Class Modeling, State Modeling and Interaction Modeling.</p> <p>Various UML Diagrams and Relationships: Use case diagram, Class diagram, Object diagrams, Aggregation, Generalization, Association and multiplicity, Activity diagram, State diagram, Sequence diagram, Collaboration diagram, Component diagram.</p>	
23	Wireless Sensor Networks	PECS-110	Introduction to wireless communication: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels: Path loss, fading, interference, Doppler effect, Transmission rate constraints. Modulation Techniques,	

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				<p>Multiple Access Techniques, wireless LANs, PANs, WANs, and MANs.</p> <p>Wireless Sensor Networks: History of Wireless Sensor Networks, Introduction to Wireless sensor networks, Key definitions, Unique constraints and challenges, Differentiate between traditional networks and wireless sensor networks, advantages of ad-hoc/sensor network, Design issues and challenges in wireless sensor networks</p> <p>Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Architecture of a wireless sensor Network, Node architecture, Protocol stack, Communication in wireless sensor network: flooding, gossiping. data dissemination and Data Aggregation</p>
24	Cloud Computing	PECS-117		<p>Cloud Computing Fundamentals: Evolution of cloud computing, Overview of computing paradigms: Distributed computing, Parallel computing, Cluster computing, Grid computing, Utility computing, Edge Computing, Fog Computing, and Cloud computing. The NIST model of cloud computing, Benefits and challenges of cloud computing, Big Data, Internet of things (IoT). Introduction to Mobile cloud computing. Cloud Concepts and Technologies: Virtualization: Definition, Characteristics and benefits of virtualization, Virtualization and cloud computing, Types of virtualization, and Load balancing, Classic datacenter, Virtualized datacenter. Hypervisors, Types of hypervisors, Multitenancy, Scalability and elasticity, Service level agreement (SLA). Cloud Architecture and Services: Cloud computing reference model architecture</p>
25	Soft Computing	PECS-122		<p>Introduction: Introduction to soft computing, Definition and importance, Evolution of soft computing, Difference between Hard and Soft computing, Requirement of Soft computing, Usefulness and applications.</p> <p>Neural Networks: Introduction to Neural Networks, Model of an artificial neuron, Comparison of artificial neural network and Biological neural network, Activation Functions, Recurrent Neural Networks, Neural network models“ Perceptron, Adaline and medaline networks, Single layer, Back propagation, Multi-layer networks</p>
26	Web Technologies	PECS-128		<p>HTML: Introduction to HTML and DHTML, History of HTML, Structure of HTML Document: Text Basics, Structure of HTML Document: Images, Multimedia, Links, Audio, Video, Table and Forms,</p>

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				<p>Document Layout, HTML vs. DHTML, Meta tags, and Website structure. Overview and features of HTML5.</p> <p>Style Sheets: Need for CSS, Introduction to CSS, Basic syntax and structure, Types of CSS – Inline, Internal and External CSS style sheets. CSS Properties - Background images, Colors and properties, Text Formatting, Margin, Padding, Positioning, CSS3- Animation, Page structure, Responsive Design, Framework - Twitter Bootstrap</p> <p>JavaScript: Introduction, JavaScript’s history and versions, Basic syntax, Variables, Data types, Statements, Operators, Functions, Arrays, Objects, Dialog boxes, JavaScript DOM, JavaScript Validations, Overview of AngularJS and NodeJS</p>
27		Cloud Computing	OECS-114	<p>Amazon Web Services (AWS) Shared Security Model: Introduction to AWS security model for cloud services, Identity and access management (IAM), Principle of least privilege (PoLP), Denial of service (DoS), Distributed denial of service (DDoS), Watering hole attack, Multi-factor authentication (MFA), Amazon inspector, AWS trusted advisor, Amazon simple storage service (Amazon S3), Amazon elastic block store (Amazon EBS), Amazon relational database service (Amazon RDS)</p> <p>Cloud Services, Instance States and Auto Scaling in Cloud Environments: Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Amazon elastic compute cloud (Amazon EC2), EC2 instance states, AWS instance lifecycle, Instance store volumes, Amazon machine image (AMI), IPv4 address and IPv6 address, Elastic IP address, Automatic scaling in cloud environments, Auto scaling groups, Fleet, Launch template, Scale-out and Scale-in.</p> <p>Dynamic Web Servers, Lambda and CloudFormation: Static website, Dynamic website, Amazon CloudFront, Content delivery network (CDN), Edge location, Origin, Distribution, Time to live (TTL), AWS Lambda, CloudFormation template, Infrastructure as code (IaC)</p>
28	M.Tech 1 st sem	Mathematical foundation of	MCS-101	<p>Unit 1: Probability mass, density, and cumulative distribution functions, Parametric families of distributions (Binomial and</p>

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		computer science		<p>Multinomial, Poisson and Normal distribution), Expected value, variance, conditional expectation, Markov and Chebyshev Inequalities, Central Limit Theorem, Markov chains</p> <p>Unit 2: Samples, populations, statistical modelling, graphical methods and data description, Random samples, sampling distributions (t-distribution and F-distribution)</p> <p>Unit 3: Statistical inference, Classical Methods of estimation</p>
29	M.Tech.	Advanced data structures	MCS-102	<p>Unit 1: Hashing: Introduction, Static Hashing – Hash table, Hash Function ,overflow Handling, Dynamic Hashing Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists</p> <p>Unit 2: Trees: Binary Search Trees, AVL Trees, Red Black Trees, B- Trees, B+-Trees, Splay Trees, Digital Search Trees, Finger search tree</p> <p>Unit 3: Heap : Binary Heaps, d-Heaps , Leftist Heaps</p>
30	M.Tech.	Advance data base system concepts	MCS-122	<p>Transaction Processing and Concurrency Control: Transaction Processing concepts, techniques: Two-phase locking, Timestamp ordering, Multiversion, Validation, Multiple Granularity locking Concurrency control. Distributed DB system concepts: Introduction, functions and architecture of a DDBMS, distributed relational database design, distributed data dictionary management, distributed transaction management, distributed concurrency control, distributed deadlock management, distributed database recovery, Distributed query optimization. Data Warehousing Concepts, OLAP and Data mining: Evolution of data warehousing, data warehousing concepts, ETL, Data Warehouse Design benefits and problems of data warehousing, Approaches to data mining problems, commercial tools of data mining, knowledge discovery, comparison of OLTP systems and data warehousing, On-Line Analytical Processing, Introduction to data mining</p>
31	M.Tech.	Research Methodology and IPR	MRM-101	<p>Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations</p> <p>Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics.</p>
32	M.Tech.	Wireless and mobile Networks	MCS-113	<p>Unit 1:</p>

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33	M.Tech. 3 rd sem	Social Network Analysis	MCS-152	<p>Overview of social media: Social Network Analysis: Brief History, Definitions, Features, Basic Concepts of Social Network Analysis, Concepts, and Research</p> <p>Graphs and Centrality: Terminology, basic graph theory, and network centrality measures.</p> <p>Social Theory and Network Topology: Sociological theories behind the formation of relationships and group structure. Introduction to Six social forces (prestige, reciprocity, homophily, propinquity, transitivity, and structural balance)</p>

Sessional Coordinator(s)

HOD(CSE)