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

Ref. No.: CSE/41/   Dated: /10.2023

S.No.	Semester	Course	Course Code	Syllabus for MSE-2
1	3rd	Object Oriented Programming	PCCS-101	Part-B Polymorphism and Type Conversion: Introduction, Concept of binding –Early binding and late binding, Virtual functions, Pure virtual functions, Operator Overloading, Rules for overloading operators, Overloading of various operators, Function overloading, Constructor overloading, Type conversion –Basic type to class type, Class type to basic type, Class type to another class type. Inheritance: Introduction, defining derived classes, Types of inheritance, Ambiguity in multiple and multipath inheritance, Virtual base class, Objects slicing, Overriding member functions, Object composition and delegation. Dynamic Memory Management using Pointers: Declaring and initializing pointers, Accessing data through pointers, Pointer arithmetic, Memory allocation –Static and Dynamic, Dynamic memory management using new and delete operators, Pointer to an object, this pointer, Pointer related problems –Dangling/wild pointers, Null pointer assignment, Memory leak and Allocation failures. Exceptions Handling: Review of traditional error handling, Basics of exception handling, Exception handling mechanism, Throwing mechanism, Catching mechanism, Rethrowing an exception, Specifying exceptions. Files Handling: File streams, Hierarchy of file stream classes, Error handling during file operations, Reading/writing of files, Accessing records randomly, Updating files.
2		Computer Networks	PCCS-102	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction- Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols- Stop and Wait, Go back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols- Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA. Part-B Network Layer: Logical addressing- IPV4, IPV6; Address mapping- ARP, RARP, BOOTP and DHCP–Delivery, Routing algorithms, Congestion control policies, Leaky bucket and token bucket algorithms. Transport Layer: Design issues, Elements of transport Protocols- Connection establishment and release, Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), flow control. Application Layer- Domain Name Space (DNS), DDNS, TELNET
3		Digital Electronics	ESCS-101	Serial adder/Subtractor, Parallel adder/ Subtractor Carry look ahead adder, BCD adder, Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker,

				code converters. Implementation of combinational logic using MUX. Sequential Circuits: Flip flops SR, JK, T, D and Master slave, Excitation table, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops. Asynchronous/Ripple counters, Synchronous counters, Modulo-n counter, Ring Counters. Classification of sequential circuits-Moore and Mealy, Design of Synchronous machines: state diagram, Circuit implementation. Shift registers. Signal Conversions: Analog & Digital signals. A/D and D/A conversion techniques (Weighted type, R-2R Ladder type, Counter Type, Dual Slope type, Successive Approximation type). Introduction to Design with PLDs: Introduction to programmable logic devices- Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA)
4		Human Values and Professional Ethics	HSMCS-101	Part B
5		Mathematics-III	BSCS-101	1) Integral calculus of functions of complex variables(Residue theorem, Evaluation of real integrals using residue theorem, Mobius transformation) 2) Probability Distribution 3) Statistics
6	5th	Artificial Intelligence	PCCS-108	Logical Reasoning: Inference in Propositional logic and First order Predicate logic, Resolution, Logical reasoning, Forward chaining, Backward chaining; Knowledge representation techniques: semantic networks, Frames. Planning: Basic representation of plans, Partial order planning, Planning in the blocks world, Hierarchical planning, Conditional planning, Representation of time, schedule and resource constraints, Measures, temporal constraints Uncertainty: Basic probability, Bayes rule and its use, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making– Utility theory, Utility functions, Decision theoretic expert systems. Inductive learning: Decision trees, Rule based learning, Current-best-hypothesis search, Least commitment search, Neural networks, Reinforcement learning, Genetic algorithms. Applications: Areas of AI, Natural language processing, Case study of existing expert systems.
7		Software Project Management	PECS-101	Project Evaluation and Planning: COCOMO II, Staffing pattern, Effect of schedule compression, Putnam's equation, Capers Jones estimating rules of thumb.

				Project Scheduling and Risk Management: Project sequencing and scheduling activities, Scheduling resources, Critical path analysis, Network planning, Risk management – Nature and types of risks, Risk planning and control, Risk assessment, Hazard identification, Hazard analysis, PERT and Monte Carlo simulation techniques. Monitoring and Control: Collecting data, Review techniques, Project termination review, Visualizing progress, Cost monitoring, Earned value analysis, Change control, Software Configuration Management (SCM), Managing contracts and acceptance. People Management: Introduction, Understanding behaviour, Organizational behaviour, Recruitment process, Motivation, The Oldman – Hackman Job Characteristics model, Stress, Health and safety. Working in teams, Decision making, Leadership, Organization and team structures. Software Quality Management: ISO Standards, Process capability models, Testing and software reliability, Quality plans, Test automation, Overview of project management tools.
8		Advanced Computer Networks	PECS-106	Part B
9		Statistics for Data Science	PECS-113	PART B Correlation: Definition of Correlation, Types of Correlation, Scatter Diagram Method, Karl Person's Correlation Coefficients, Correlation Coefficients for Bivariate frequency distribution, Probable error for Correlation Coefficients, Rank Correlation Co-efficient. Regression: Definition of Regression, Regression lines, Regression Coefficients, Properties of regression Coefficients, and Fitting of regression lines and estimation for Bivariate frequency distribution, Multiple Linear Regression. Testing of hypothesis: Meaning, Basic concepts, Flow diagram, Power of a hypothesis test, Important parametric tests,Types of hypothesis (null and alternate), Limitations of tests of hypothesis. Statistical analysis: Parametric tests, Non-parametric tests, Students t-test, chi square test, analysis of variance (ANOVA).
10		Information Retrieval	PECS-116	N-Grams, Regression Analysis; Thesauri; Semantic Networks; Parsing, Searching Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Structural queries;

				Compression. Cross Language Information Retrieval and Efficiency, Integrating Structured Data and Text: Introduction; Crossing the language barrier; Cross Language retrieval strategies; Cross language utilities. Duplicate Document Detection. Review of the relational model; a historical progression; Information retrieval as a relational application; Semi-structured search using a relational schema. Parallel Information Retrieval and Distributed Information Retrieval: Parallel text scanning; parallel indexing; Clustering and classification; Large parallel systems; A theoretic model of distributed information retrieval; Web search; Result fusion; Other architectures. Multimedia IR: Introduction; data modeling; Query languages; Spatial access methods; A general multimedia indexing approach; One-dimensional time series; Two-dimensional color images.
11		System Programming	PECS-125	Macro and Macro Processors: Introduction, Macro Definition and Call, Macro Expansion, Nested Macro calls, Advanced Macro Facilities, Design of a Macro Pre-processor, design of a Macro Assembler, Functions of a Macro Processor. Linkers and Loaders: Linkers - Relocation of Linking Concept, Design of a Linker, Self-Relocating Programs, Linking of Overlay Structured Programs, Dynamic Linking. Loaders - Different Loading Schemes, Sequential and Direct Loaders, Compile-and-Go Loaders, General Loader Schemes, Absolute Loaders, Relocating Loaders, Linker v/s Loader. Scanning and Parsing: Programming Language Grammars, Classification of Grammar, Ambiguity in Grammar Specification, Scanning, Parsing, Top Down Parsing, Bottom up Parsing, Language Processor Development Tools - LEX, YACC. Compilers: Causes of Large Semantic Gap, Compiler and its phases – lexical, syntax and semantic analysis, intermediate code generation, code optimization and code generation. Interpreters and Debuggers: Interpreters - Overview of interpreters, Benefits of Interpretation. Types of Errors, Debugging Procedures, Classification of Debuggers, Dynamic/Interactive Debuggers.
12		Database Management Systems	PCCS-109	Part-B Relational Database Design: Informal design guidelines for Relational Schemas, Functional dependencies, Inference rules for functional dependencies, Equivalence of set of functional dependencies, 2QMinimal cover, Normal forms based on primary keys– (1stNF, 2ndNF, 3rdNF, 4thNF and 5thNF) Decomposition into normalized relations. Physical Database Design – File structures (Sequential files, Indexing, B tree). Transaction Management and Concurrency Control: Introduction to Transaction Processing, Transaction and System Concepts, need of concurrency control, ACID properties, Schedules, Characterizing schedules based on recoverability and serializability, Two - phase locking techniques for concurrency control. Database Recovery and Security: Need of recovery, Recovery concepts, Recovery techniques Deferred update, Immediate update, Shadow paging. Database security – Threats to databases, Control measures, Database security and DBA, Discretionary access control based on

				granting and revoking privilege's ,Mandatory access control, Introduction to Statistical Database Security, Encryption and decryption.
13		Formal Language & Automata Theory	PCCS-110	Push Down Automata: Description and definition, Acceptance by Push Down Automata, Equivalence of Push Down Automata and context free grammars and languages. Turing Machine: Definition and Model, Representation of Turing Machine, Design of Turing Machine, Variants of Turing Machine, Decidability and recursively enumerable languages, Halting problem, Post correspondence problem Context Sensitive Language: Context sensitive language, Model of linear bounded automata, Relation between linear bounded automata and context sensitive language.
14		Design and Analysis of Algorithms	PCCS-111	Backtracking: General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. Application of Graph Traversal Techniques: Representation of graphs, BFS (as a method for SSSP on unweighted graphs), DFS, connected components, topological sorting of DAGs, biconnected components, and strongly connected components in directed graphs. String Matching: Introduction, Brute Force algorithm, Rabin-Karp algorithm, KMP algorithm, Boyer-Moore algorithm. NP Completeness: classes NP, P, NP-complete, and polynomial time reductions, Introduction to approximation algorithms, Absolute approximations, E-approximations.
16	7th	Agile Software Development	PECS-103	PART-B Design Methodologies: Need of scrum, Scrum practices – Working of scrum, Project velocity, Burn down chart, Sprint backlog, Sprint planning and retrospective, Daily scrum, Scrum roles– Product Owner, Scrum Master, Scrum Team. Extreme Programming- Core principles, values and practices. Kanban, Feature-driven development, Lean software development. Testing: The Agile lifecycle and its impact on testing, Test driven development– Acceptance tests and verifying stories, writing a user acceptance test, Developing effective test suites, Continuous integration, Code refactoring. Risk based testing, Regression tests, Test automation.
17		Software Defined Networks	PECS-109	Part B
18		Data Warehouse and Data Mining	PECS-115	Part-B Data Mining Techniques: Introduction to Data Preprocessing, Data Preprocessing Methods, Introduction to Classification, Types of Classification, Input and Output Attributes, Working of Classification, Guidelines for Size and Quality of the Training Dataset, Decision Tree Classifier, Naïve Bayes Method. Cluster Analysis and Association Mining: Cluster Analysis, Applications of Cluster Analysis , Desired Features of Clustering , Distance Metrics: Euclidean distance, Manhattan

				distance, Chebyshev distance, Major Clustering Methods/Algorithms, Partitioning Clustering, Hierarchical Clustering Algorithms (HCA), Introduction to Association Rule Mining, Defining Association Rule Mining, Representations of Items for Association Mining, The Metrics to Evaluate the Strength of Association Rules, The Apriori Algorithm. Data mining tools, Applications and Case Studies: Introduction to WEKA, Application of Data Warehousing (Data Visualization) and Data Mining (Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining) Study 1: OLAP for the Fast Food Industry Study 2: Intrusion Detection using kNN classification
19		Computer Vision	PECS-121	Visual Features and Representations:Scale Space and Scale Selection; SIFT, SURF; HoG, LBP Feature Detection and Matching: Human Visual System, Feature Matching. Hough transform; From points to Images: Bag-of-words, VLAD Representations; RANSAC, Image Descriptor Matching, Pyramid Matching. Segmentation and Pattern Analysis: Region Splitting and Merging, Edge Based approaches to segmentation, Graph-Cut,K-Means and mixtures of Gaussians, Mean-Shift, MRFs, Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA
20		Advanced Algorithm Design and Analysis	PECS-127	Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, randomized algorithms, Probabilistic analysis and further uses of indicator random variables. Flow networks: Introduction to flow networks, The Ford-Fulkerson method, Maximum bipartite matching, Push-relabel algorithms, The relabel-to-front algorithm. Multithreaded Algorithms: Introduction, Dynamic multithreaded programming, The basics of dynamic multithreading: A model for multithreaded execution, Multithreaded matrix multiplication, Multithreaded merge sort.
21		Object Oriented Design using UML	PECS-104	Part B

22		Wireless Sensor Networks	PECS-110	MAC Protocols in WSN: Overview, design issues in MAC protocols, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, classification of MAC protocols, Contention Free MAC Protocols, Contention-Based MAC Protocols with Reservation, Contention-Based MAC Protocols with Scheduling Mechanisms and Hybrid MAC Protocols Routing Protocols: Overview, Routing metrics, Issues in designing a routing protocol, Flooding and Gossiping classification of routing protocols, Data-Centric Routing, Proactive Routing/ table-driven, On-Demand Routing, Hierarchical Routing, Location-Based Routing and QoS-Based Routing Protocols. Applications and Future Trends: Applications and case studies on Structural Health Monitoring, Habitat Monitoring, Health Monitoring, Traffic Control, Precision Agriculture, Tracking Chemical Plumes. Future Research Directions: Security and privacy in sensor networks, Embedded Systems Networks of High-Data-Rate Sensors Light weight Signal Processing
23		Cloud Computing	PECS-117	Cloud Architecture and Services: Common Cloud Management Platform (CCMP), Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud-based services and applications: Cloud computing for healthcare, Energy systems, Transportation systems, Manufacturing industry, Government, and Education. Cloud deployment models: Public, Private, Community, and Hybrid cloud. Security in Clouds: Cloud security issues and challenges, Cloud security reference model, Encryption techniques: Symmetric key encryption and Asymmetric key encryption. Identity and key management, Digital signature, Secure Socket Layer (SSL). Cloud Computing Platforms: Study and comparison of various open source and commercial cloud platforms.
24		Soft Computing	PECS-122	Fuzzy Logic: Crisp and fuzzy sets, Fuzzy sets – Membership functions, Basic operations, Properties and fuzzy relations, Predicate logic, Fuzzy Decision Making, Fuzzy rule based system, Fuzzy inference system, Applications of fuzzy logic. Genetic Algorithms: Working principle– Crossover, Mutation, Encoding, Fitness function and Reproduction, Classification of genetic algorithm, Multi-objective genetic algorithm, Application of GA in search and optimization.

				Nature Inspired Algorithms: Cukcoo Search Algorithm, Fire Fly Algorithm, Fruit Fly Algorithm, Bat Algorithm, Particle Swarm Optimization, Bee Colony Optimization, Ant Colony Optimization.
25		Web Technologies	PECS-128	Introduction: History and evolution of Internet protocols, Internet addressing, Internet Service Provider (ISP), Introduction to WWW, DNS, URLS, HTTP, HTTPS, SSL, Web browsers, Cookies, Web servers, Proxy servers, Web applications PHP and MySQL: Introduction and basic syntax -of PHP, Data types, Variables, Decision and looping with examples, String, Functions, Array, Form processing, Cookies and Sessions Management, E-mail, PHP-MySQL: Connection to server, Creating database, Selecting a database, Listing database, Listing table names, Creating a table, inserting data, altering tables, queries, Deleting database, Deleting data and tables, and Overview of Model View Controller platform Search Engine Optimization: Deploying a website on server, Search engine optimization and its different types, Web application testing and security, Web APIs
26		Cloud Computing	OECS-114	Automatic scaling in cloud environments, Auto scaling groups, Fleet, Launch template, Scale-out and Scale-in. Artificial Intelligence (AI) and Machine Learning (ML): Introduction to AI and ML, AWS DeepLens, AI services from AWS platform: Amazon Comprehend, Amazon Forecast, Amazon Lex, Amazon Personalize, Amazon Polly, Amazon Rekognition, Amazon Textract, Amazon Translate, Amazon Transcribe. Impact of AI, Deep learning, Reinforcement learning, Supervised learning, Unsupervised learning, Forecasting, Neural network, AWS machine learning applications. Internet of Things (IoT) and Big Data: Introduction to IoT and Big data, AWS IoT services, Apache Hadoop, Big data processing cycle, Data analytics, AWS Big data applications and services. Blockchain and Cryptocurrency: Introduction to blockchain technology, Cryptocurrency, Cryptocurrency mining, Decentralized database, Hash, Immutable transactions, Smart contract, AWS blockchain products.
27	M.Tech 1st sem	Mathematical foundation of computer science	MCS-101	Statistical hypothesis: general concepts 7 Unit 4: Graph Theory: Isomorphism, Planar graphs, graph coloring theorem: Art Gallery problem, Hamilton circuitsand Euler cycles, Permutations and Combinations with and without repetition. Techniques to solve combinatorial enumeration problems: Binomial coefficients, Multinomial coefficients. 7

				Unit 5:Computer science and engineering applications: Data mining, Network protocols: Resource Allocation and Congestion Control, analysis of Web traffic, Bioinformatics, Machine learning.
28	M.Tech.	Advanced data structures	MCS-102	Skew Heaps , Binomial Heaps , Fibonacci Heaps 7 Unit 4: Text Processing: Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, The Huffman Coding Algorithm , The Longest Common Subsequence Problem (LCS), Tries- Standard Tries, Compressed Tries, Suffix Tries 7 Unit 5 Multidimensional Searching: One Dimensional Range Searching, Two Dimensional RangeSearching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.
29	M.Tech.	Advance data base system concepts	MCS-122	Unit 2: XML Query Processing: XML query languages: XML-QL, Lorel, Quilt, XQL, XQuery, and Approaches for XML query processing, Query processing on relational structure and storage schema, XML database management system. Unit 4:Web Databases: Web Technology and DBMS, Introduction, The Web as a Database Application Platform, Scripting languages, Common Gateway Interface, Extending the Web Server, Oracle Internet Platform, Semi structured Data and XML, XML Related Technologies. Unit 6: Emerging Database Models, Technologies and Applications: Multimedia database, Geography databases, Gnome databases, Knowledge databases, deductive databases and semantic databases, Spatial database, Information visualization
30	M.Tech.	Research Methodology and IPR	MRM-101	UNIT 3,4,5,6
31	M.Tech.	Wireless and mobile Networks	MCS-113	Wireless cellular network, Yimax , Mobile IP Wireless sensor network
32	M.Tech. 3rd sem	Social Network Analysis	MCS-152	Clustering coefficient, density, and other graph-level and community measures, Clustering and Subgroup Analysis: A review of common clustering algorithms for use in networks and their application. Block modelling, modularity, graph reduction, localized network measure. Statistical Analysis of Networks: Introduction to exponential random graph models. Hypothesis testing and time series analysis.

Sessional Coordinator(s)   **HOD(CSE)**

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