Subject Name & Subject Code	Semester	Syllabus for MSE 2
Object Oriented Programming (PCCS-101)	3rd	**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.
Computer Networks (PCCS-102)	3rd	Sliding Window, Piggybacking, Random Access. 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. Session, Presentation and Application Layer: Session Layer- Design issue, remote procedure call. Presentation Layer- Design issue, Data compression techniques. Application Layer- Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP.
Digital Electronics (ESCS-101)	3rd	**Combinational Circuiits:** Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker, 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).

Human Values and Professional Ethics (HSMCS-101)	3rd	-----------------------------------
Mathematics III (BSCS-101)	3rd	Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines and second degree parabolas Probability Distributions: Probbility spaces, Discrete random variables, Poisson and binomial distribution. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Statistics: Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Small sample test for single mean and difference of means, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.
Artificial Intelligence (PCCS-108)	5th	Part B 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.
Database Management Systems (PCCS-109)	5th	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– (1 st NF, 2 ndNF, 3 rdNF, 4 thNF and 5 thNF) 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 privileges, Mandatory access control, Introduction to Statistical Database Security, Encryption and decryption.

Subject	Sem	Syllabus
Formal Language & Automata Theory (PCCS-110)	5th	**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.
Design and Analysis of Algorithms (PCCS-111)	5th	**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.
Software Project Management (PECS-101)	5th	---
Advanced Computer Networks (PECS-107)	5th	**Virtual LANs (VLANs):** purpose, memberships, configuration, connection between switches, advantages, types of VLANs: static and dynamic. **TCP Protocols:** Internet Protocol (IP): service model, global addresses, datagram forwarding in IP, subnetting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error reporting (ICMP). **Routing:** Network as a graph, Distance Vector (RIP), Link state (OSPF), metrics. Inter-domain routing: routing policies, routing protocols (BGP), Intra-domain routing: routing policies, routing protocols (DVMRP). **Transport Service and Protocols:** User Datagram Protocol (UDP): header format, services, and applications, Transmission Control Protocol (TCP): transport service characteristics; transport protocol: features, segment, TCP connection. **Wireless Ad hoc Networks:** Mobile Ad hoc Networks (MANETs): features, advantages, routing in MANETs, applications of MANETs, Recent trends in networks: green networking, social networks, software data networks and vehicular ad hoc networks (VANETs).

Statistics for Data Science (PECS-113)	5th	Standard errors of estimates, Interquartile range. 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).
Information Retrieval (PECS-119)	5th	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.
System Programming (PECS-125)	5th	**Linkers and Loaders:** Linkers - Relocation of Linking Concept, Design of a Linker, SelfRelocating 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 Debuggers. Procedures, Classification of Debuggers, Dynamic/Interactive
Organizational Behaviour (MCI-103)	5th	--------------------------------
Constitution of India (MCI-102)	5th	--------------------------------

Preparation and Analysis of Data (PECS-133)	7th	Advanced Data Analysis Techniques: Time series analysis and forecasting, Dimensionality reduction methods (e.g. i.e., PCA, t-SNE etc.), Feature selection and engineering, Ensemble learning techniques (e.g. i.e., random forests, gradient boosting etc.).Data Visualization and Communication: Importance of data visualization in understanding and communicating data, Overview of different types of visualizations (bar charts, line charts, scatter plots, etc.), Principles of effective data visualization (clarity, simplicity, accuracy etc.), Introduction to popular data visualization tools (e.g. i.e., Matplotlib, Seaborn, ggplot2 etc.). Ethical and Legal Considerations: Ethical issues in data analysis and interpretation, Data privacy and confidentiality, Compliance with regulations such as GDPR and HIPAA. Real-World Applications and Case Studies: Application of data preparation and analysis techniques in various domains (e.g. i.e., healthcare, finance, marketing etc.), Case studies and practical examples from industry.
Data Warehouse and Data Mining (PECS-115)	7th	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
Computer Vision (PECS-121)	7th	Part BFeature 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, Semi- supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA Applications of Computer Vision: Motion Estimation and Object Tracking, Gesture Recognition, Face and Facial Expression Recognition, Image Fusion.
Design and Analysis of Advanced Algorithms (PECS-132)	7th	PART-B 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, Maximumbipartite 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.
OE* Cloud Computing-II (OECS-114)	7th	**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.
Applied Cloud Computing (PECS-135)	7th	**Cloud Security and Cloud Monitoring:** Cloud Security: AWS Identity and Access Management (IAM), Role, User, Security group, Policy, Amazon Inspector, Root User, Credential, Multi-Factor Authentication (MFA), AWS shield, AWS Web Application Firewall (WAF), Distributed Denial of Service (DDoS), AWS Artifact. Cloud Monitoring: Amazon CloudWatch, AWS CloudTrail, AWS Config, Amazon Simple Notification Service (Amazon SNS). **Databases and Load Balancing:** Databases: Relational database, Amazon Relational Database Service (Amazon RDS), Non relational database, Amazon DynamoDB, Amazon Redshift, Online Transaction Processing (OLTP), Online Analytic Processing (OLAP), Amazon Aurora, MySQL. Load balancing: Load balancer, Amazon ElastiCache, Data Caching, Elastic Load Balancing, Random Access Memory (RAM). **Elastic Beanstalk, CloudFormation, Billing and Support:** AWS Elastic Beanstalk, AWS CloudFormation, Stack. Billing and Support: AWS simple monthly calculator, AWS support plan, Consolidated billing, Technical Account Manager (TAM). **Emerging Technologies in Cloud and Cloud Optimization:** Artificial Intelligence (AI), Machine Learning (ML), Amazon SageMaker, Deep Learning, AWS DeepRacer, AWS DeepLens, Neural network, Blockchain technology. Cloud optimization using AWS Cloud Development Kit (CDK).
Soft Computing (PECS-122)	7th	**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.
Web Technologies (PECS-128)	7th	JavaScript: Overview of AngularJS and NodeJS. 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

MSE Coordinator

Head of Department