S.No	Semester	Course	Course Code	Syllabus for MST 1
1.	4th	Discrete Mathematics	PCCS-103	Fundamentals of Sets, Relations and Functions: Sets – Operations on sets, Subsets, Types of sets, Ordered pairs, Proofs of general identities of sets, Classes of sets and partitions, Countable and uncountable sets. Relations – Representations of relations, Types of relations, Composition of relations, Closure properties of relations, Equivalence relations, Compatibility relations, Partial order relations. Functions – Introduction and types of functions, Sum and product of functions, Hashing functions, Recursively defined functions Combinatorial Mathematics: Basic counting principles, Permutations and combinations, Pigeonhole principle, Inclusion and exclusion principle, Recurrence relations – Solving homogeneous and nonhomogeneous recurrence relations, Sequences, Generating function.
2.	4th	Computer Architecture & Microprocessor	PCCS-104	Module 1 Data Representation: Data types, Complements, Fixed point representation, Floating point representation, Error detection and correction. Module 2 Register Transfer and Micro-operations: Addition, Subtraction, Multiplication and division algorithms and hardware, Register transfer language and operations, Arithmetic micro-operations, Logic micro-operations, Shift micro-operations, Arithmetic logic shift unit. Module 3 Computer Organization and Design: Instruction codes, Computer registers, Computer instructions, Timing and control, Instruction cycle, Memory reference instructions, Input/ Output and interrupts, Design and working of a complete basic computer, Control functions, Design of accumulator logic.
3.	4th	Operating Systems	PCCS-105	Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Case study on UNIX and WINDOWS Operating System. Process management: Concept of processes and threads, Definition, Process and Program, Different

				states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads.
4.	4th	Data Structures	PCCS-106	Part A: Basic Concepts, Arrays, Stacks, Queues, Linked List
5.	4th	Software Engineering	PCCS-107	Introduction: Evolution and impact of software engineering, Software myths, Software application domains, Software crisis – Problem and causes. Software Process Models: Software process, Software process models – Waterfall model, Prototype model, Spiral model, Evolutionary model, RAD model, V-model and Component based model. Requirements Engineering: Feasibility study, Problem analysis, Requirement elicitation and specification, Functional and non-functional requirements, Software requirements specification document, Requirement validation and management. Project Management and Risk Analysis: Project planning, Cost estimation techniques– Size metrics, Empirical estimation, Heuristic estimation and analytical estimation, Manpower management, Risk management-Identification, Analysis, Planning and Monitoring.
6.	4th	Environmental Sciences	MCCS-101	Natural Resource ,Water resources, Ecosystem
7.	6th	Compiler Design	PCCS-112	Introduction to Compiler: Language Processors, The Structure of a Compiler, The Grouping of Phases intoPasses, Applications of Compiler Technology, Programming Language Basics. Lexical Analysis: Role of lexical analyzer, Tokens, Patterns, and Lexemes, Attributes for Tokens, Lexical Errors, Input Buffering, Sentinels, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator Lex, Finite Automata. Syntax Analysis: Introduction, Role of the parser, Context-Free Grammars (CFG), Writing a Grammar, Writing a Grammar, Top down parsing –Backtracking, LL(1), Recursive descent parsing, Non-recursive Predictive Parsing. Bottom-up parsing – Shift reduce parsing
8.	6th	Computer Graphics	PCCS-113	Introduction: Overview of computer graphics, Computer graphics applications, Different I/O devices with

				specialized graphics features, Elements of graphics. Graphic systems – Video display devices, Raster scan systems, Random scan systems. Video basics – Video controller, Raster-scan display processor. 2D Primitives: Scan conversion basics, Algorithm for scan converting a point, Scan converting a line –Digital differential analyser algorithm, Bresenham's line algorithm. Scan converting circle – Bresenham's circle drawing algorithm, Midpoint circle drawing algorithm. Scan converting ellipse– Midpoint ellipse algorithm. Filling Techniques – Scan line polygon fill algorithm, Boundary-fill, Flood-fill. Anti-aliasing.
9.	6th	Machine Learning	PCCS-114	Introduction: Well defined learning problems, defining a learning system, perspectives and issues in machine learning, the concept learning task, concept learning as search, Find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Inductive bias, probability theory. Supervised Learning: Basic methods: Distance based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, and Linear models: Linear regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and kernel Methods. Unsupervised Learning: Clustering: k-means/ kernel k-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative models (mixture models and latent factor models). Decision Tree Learning: Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Ensemble methods- Bagging, Gradient Boosting, Random Forest.
10.	6th	Cyber Security	PCCS-115	PART A: Introduction to Cyber Space, Secure Social Media Usage and Security, E-Commerce Security
11.	6th	Software Testing & Quality Assurance	PECS-102	PART-A: Introduction, Testing Principles and basic concepts, Test planning and execution

12.	6th	Network Security & Cryptography	PECS-108	Introduction to Security: Essentials of network security, Architecture, Security goals, cryptographic attacks: cryptanalytic, non-cryptanalytic attacks, active attack and passive attack, security Services and security mechanism, Fundamental Security design principles, Network security model, standards. [5 Hours] Number Theory: Integer Arithmetic, Euclidean Algorithm, Extended Euclidean Algorithm, Modular Arithmetic, Matrices, Linear Congruence, Prime numbers, Fermat's and Eular's Theorem, Factorization, Chinese Remainder Theorem. [6 Hours] Classical Encryption Techniques: Encryption, Decryption, Plaintext, Cipher text, Key range and Size, Symmetric cipher model, Substitution techniques: Mono-alphabetic ciphers (additive, Caesar
13.	6th	Advance Database Management System	PECS-114	Introduction to SQL Programming Techniques: Database Programming: Issues and Techniques, Embedded SQL, Dynamic SQL, Database Programming: Data Types, Variables, Constraints, Operators, Conditions, Loops, Strings, Arrays, Procedures, Functions, Cursors, Records, Exceptions, Triggers, Packages, Database Stored Procedures. [5 Hours] Transaction Processing and Optimization: Transaction Processing Concepts, Concurrency Control Techniques, Timestamp ordering, Multiversion Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques, Granularity of Data Items and Multiple Granularity Locking. [4 Hours] Query Processing and Optimization: Query Processing, Syntax Analyzer, Query decomposition, Query Optimization, Heuristic Query Optimization, Algorithms for SELECT and JOIN Operations, Handling, Package and Triggers. (Change from Level-2 to Level 3 or above) and R the concept of transaction, concurrency control and recovery in 4 Illustrate the concept of object oriented database and have experience with object oriented modeling, design and implementation. (Change from Level-2 to Level 3 or

				above) List the principles of distributed systems and describe the problems and challenges associated with these principles. Scheme and syllabus of B.Tech. (2018 batch onwards) Algorithms for PROJECT and Set Operations, Implementing Aggregate Operations and OUTER JOINS. Using Selectivity and Cost Estimation in Query Optimization. Semantic Query Optimization. [5 Hours] Object-Oriented DBMS: Introduction Advanced Database Applications, Weakness of RDBMS, Storing Objects in Relational Database. Next- Generation Database Systems, OODBMS Perspectives, Persistence, Issues in OODBMS, Advantages and Disadvantages of OODBMS, Object-Oriented Database Design, Comparison of ORDBMS and OODBMS.
14.	6th	Natural Language Processing	PECS-120	Introduction: Introduction to natural language and speech processing, Steps for processing natural languages, Issues and challenges for processing of natural languages, Elements of information theory, Brief history of natural language processing. Morphological Analysis: Inflectional and Derivational morphology, Morphological parsing, Lexicon and Morphotactics, Finite state transducers, N-gram language models, N-gram smoothing, Entropy. Part-of-Speech Tagging: Word classes, Part-of-speech tagging, Tagsets, POS tagging Techniques – Rule-based, Stochastic, Transformation-based. Applications: Different application areas of natural language processing – Machine translation, Machine learning, Text categorisation and summarisation, Speech synthesis, Speech recognition, Optical character recognition, Database access, etc.
15.	6th	Java Programming	PECS-126	Introduction: History of Java, Importance of Java to the internet, Java's Magic – The Byte code features of Java, Overview of Java. Java Basics: Data-types, Variables, Arrays, Operators, Expressions, Control statements, Type conversion, Concepts of classes and objects, Constructors, Methods, Access control, this keyword, Garbage collection, Overloading methods and constructors,

				Parameter passing, Recursion, Understanding static, Introducing nested and inner classes, Using command line arguments, Introduction to string handling. Inheritance: Basics of inheritance, Types of inheritance, Member access rules, Using super, Using final with inheritance, Method overriding, Dynamic method dispatch, Using abstract classes. Packages and Interfaces: Defining a package, Accessing a package, Understanding CLASSPATH, Importing packages, Differences between classes and interfaces, defining an interface, implementing interface, Variables in interface, Extending interfaces Multithreading: Java thread life cycle, Creating threads, Using isAlive() and join(), Synchronization, Interthread communication, Suspending, resuming, stopping threads.
16.	6th	Software Project Management	OECS-101	
17.	6th	Cloud Computing	OECS-113	
18.	8th	Component Based Development	PECS-107	Component Definition: Definition of Software Component and its Elements. Component Models and Component Services: Concepts and Principles, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High-Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization. Software Engineering Practices: The Practice of Software Engineering, From Subroutines to Subsystems:Component-Based Software Development. The Design of Software Component Infrastructures: Software Components and the UML, Placing Software Components in Context, Business Components
19.	8th	Internet of Things	PECS-112	Part-A Introduction to Internet of Things (IoT): IoT Definition, IoT Vision, Smart and Hyper-connected Devices, Conceptual Framework, Architectural View, Technology behind IoT, Major Components of IoT System, Sources of IoT, Examples of IoT. [6 Hours] IoT & M2M: Difference between IoT and

				Machine to Machine, M2M Architecture, SNMP protocol, IoT reference model, Lightweight M2M Communication Protocol, Domain model - information model, functional model, communication model. [6 Hours] Design Principles for Web Connectivity: Constrained Application Protocol, JSON (Java Script Object Notation) Format, Tag Length Value Format, MIME (Multipurpose Internet Mail Extension)Type, Message Communication Protocols for Connected Devices, Web Connectivity for Connected Devices Network. [6 Hours]
20.	8th	Data Science	PECS-119	Introduction: Introduction to Data Science, Introduction to Big Data, Relationship between Big Data and Data Science, Benefits and uses of Data science and Big data. Data Structure: Structured vs Unstructured Data. Drivers of big data, Data Growth-issues and challenges, Data Science vs Business Intelligence. Data Collection and Data Science Process: Sources of Data, Data collection and APIs, Data Science Process: Goal setting, retrieving data, data preparation, data cleansing and transformation, exploratory data analysis, data visualization, Model building and performance evaluation, presentation. Data Representation: Various Forms of data, Text data, Graph-based data. Modern databases- text files, spreadsheets, SQL databases, NoSQL databases, Distributed databases, Live data streams, Image, Sensor and Network data. Dataset Terminology: Observations and variables, Discrete and Continuous variables, Quantitative and Qualitative variables, Dependent and Independent variables.
21.	8th	Deep Learning	PECS-124	Introduction: Deep Learning definition, why Deep Learning, history of Deep Learning, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Convergence theorem for Perceptron Learning Algorithm. Feedforward Networks: Multilayer Perceptron, Representation power of Feedforward Neural Networks, Backpropagation Gradient Descent, Empirical Risk Minimization, autoencoders.

				Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training, Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training,
22.	8th	Mobile Application Development	PECS-130	PART-A Introduction: Introduction to mobile applications, Market and business drivers for mobile applications, Publishing and delivery of mobile applications, Requirements gathering and validation for mobile applications, Different types of Mobile Applications – Native Application Development and Hybrid Mobile Application Development. Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file. Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.
23.	8th	Business Information Systems	OECS-106	Introduction to Business Information System: Introduction to Information System, Impact of IS in Business, Transformation from Old to Digital Economy, Acquiring Information system, Components of IS, Resources that support BIS, Types of BIS, E-business system. [6 hours] Business Development of Data Systems- Overview of Hardware and Software, Networks, Network Components, Telecommunication and Internet, Scenario in India, Networking Technologies- Wi-Fi, WiMax, NextGen mobile networks, Data Capture and Computer Input / Output devices. [5 hours] Data Resource Management: Differentiating Data and Information, Traditional Processing Systems, Functionalities of Database approach and its advantages and disadvantages, Components of database environment, Concepts of Data Warehousing, Data Mining and Tools, OLAP, Data Visualization, Data Centers, Fabric Data Centers, Server Farms, Big data overview, V's of big data,

				Drivers of big data, Big data ecosystem and a New Approach to Analytic
24.	8th	Cloud Computing	OECS-114	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) 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.
25.	8th	Software Metrics	PECS-105	Software Metrics, Complexity Metrics and Models, Estimate internal product attributes
26.	8th	Blockchain Technology	PECS-113	Introduction to Cryptography: Need of Cryptography, Traditional and Modern techniques, Hash function, Distributed Hash Table, Digital Signatures, Symmetric and Asymmetric Key Cryptography, Zero Knowledge Proof, Double Spending problem. Introduction to Blockchain: Distributed Database, shortcomings of current transaction systems, distributed network, difference between blockchain and traditional database, evolution of blockchain. Bitcoin's Architecture, Blockchain Architecture: merkle root tree, gas limit, transactions and fee, nonce value, anonymity, reward, chain policy, miners, validators, types (private and public blockchains), Challenges to Blockchain Implementation, Features of Blockchain Network, Soft & Hard Fork. Distributed Consensus I: The mining mechanism, Two Generals Problem, Byzantine General problem and Fault Tolerance, Nakamoto consensus, Evaluation aspects Blockchain

				consensus protocols: Scalability, Throughput (TPS), Latency, Security, Fault Tolerance Rate, Energy
27.	8th	Big Data	PECS-118	
28.	8th	Parallel & Distributed Algorithms	PECS-129	Part A of syllabus