

St. Xavier's College (Autonomous), Kolkata

Postgraduate and Research Department of Computer Sc.

MSc Computer Science Syllabus – Academic Session 2021-22 onwards

SEM NO	PAPER NO	PAPER TYPE	PAPER	TYPE	MARKS	CREDITS	CLASSES PER WEEK (13 weeks)		
							TH	PR	TUT
1	1	CORE - 1	DESIGN AND ANALYSIS OF ALGORITHMS	Composite	60+40	4+2=6	4	4	X
	2	CORE - 2	ADVANCED DATABASE MANAGEMENT SYSTEM AND DATA WAREHOUSING	Composite	60+40	4+2=6	4	4	X
	3	CORE - 3	ADVANCED OPERATING SYSTEM	Composite	60+40	4+2=6	4	4	X
	4	CORE - 4	ADVANCED COMPUTER ARCHITECTURE	Theory	100	6	5	X	1
2	1	CORE - 5	MICROCONTROLLER AND EMBEDDED SYSTEMS	Composite	60+40	4+2=6	4	4	X
	2	CORE - 6	ADVANCED COMPUTER NETWORKS	Theory	100	6	5	X	1
	3	CORE - 7	COMPILER DESIGN	Theory	100	6	5	X	1
	4	CORE - 8	INTERNET TECHNOLOGIES	Practical	100	6	X	8	2
3	1	CORE - 9	SOFTWARE ENGINEERING & DESIGN	Composite	60+40	4+2=6	4	4	X
	2	CORE - 10	ARTIFICIAL INTELLIGENCE	Composite	60+40	4+2=6	4	4	X
	3	IDE-1	INTER DISCIPLINARY ELECTIVE	Theory	50	3	3	X	0
	4	DSE-1	DISCIPLINE SPECIFIC ELECTIVE	Theory	50	3			
	5	DSE-2	DISCIPLINE SPECIFIC ELECTIVE		60+40/100	6			
4	1	CORE - 11	IOT AND VLSI DESIGN	Theory	100	6	6	X	X
	2	DSE-3	DISCIPLINE SPECIFIC ELECTIVE		60+40/100	6			
	3	DSE-4	DISCIPLINE SPECIFIC ELECTIVE		60+40/100	6			
	4	PROJECT	PROJECT	Project	100	6	X	X	X

TOTAL MARKS: 1600

CORE PAPERS: 11

DISCIPLINE SPECIFIC ELECTIVES: 4

PROJECT: 1

TOTAL CREDITS: 96

DISCIPLINE SPECIFIC ELECTIVES (DSE) (100):

- DSE 1: DIGITAL IMAGE PROCESSING – COMPOSITE
- DSE 2: FOUNDATIONS OF DATA SCIENCE – COMPOSITE
- DSE 3: SOFT COMPUTING - THEORY
- DSE 4: MACHINE LEARNING AND DATA MINING – COMPOSITE
- DSE 5: MOBILE COMMUNICATION - THEORY

DISCIPLINE SPECIFIC ELECTIVES (DSE) (50):

- DSE 6 ECOMMERCE
- DSE 7 CLOUD COMPUTING
- DSE 8 INFORMATION SECURITY AND CYBER LAW

INTER-DISCIPLINARY ELECTIVE (IDE) (50):

- IDE 1 INFORMATION SECURITY AND CYBER LAW
- IDE 2 INTERNET OF THINGS

CMSM CORE 1 Composite - MCMS 4111

Design and Analysis of Algorithms (Theory – 60 marks)

Review of basic algorithmic analysis: Asymptotic analysis of upper and average complexity bounds; best, average, and worst case behaviors; big-Oh, big-Omega and big-Theta; standard complexity classes; empirical measurements of performance; time and space tradeoffs in algorithms; recurrence relations

Divide and Conquer: Merge Sort, Quick Sort, Selection Problem, Median and Order Statistics, Strassen's Matrix Multiplication, Convex Hull Algorithms.

Greedy Algorithm: Knapsack algorithm, Huffman Codes, Task Scheduling

Dynamic Programming: Chained matrix multiplication

Backtracking Algorithms: 8 queens problem

Branch and Bound: Travelling Salesperson problem.

Graph and Tree Algorithms: BFS, DFS, Topological Sort, Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Dijkstra's Algorithm, Bellman Ford Algorithm, Bipartite Graphs, Binary Search Tree, AVL tree, 2-3 Tree, Red Black Tree, Binomial Heaps.

Complexity Theory: Tractable and intractable problems, Concepts of computable functions; Polynomial reducibility: P and NP: Definition of the classes P and NP, NP-completeness (Cook's theorem), Standard NP complete problems.

LAB: Design and Analysis of Algorithms (40 marks)

Books and References:

1. T. H. Cormen et al -Introduction to Algorithms , PHI
2. E. Horowitz, S. Sahani - Fundamentals of Computer Algorithms – Galgotia
3. Bratley et al - Fundamentals of Algorithms-PHI

CMSM Core 2 Composite - MCMS 4112

Advanced Database Management System and Data Warehousing (Theory – 60 marks)

Transaction Management and Concurrency Control: States of Transaction, ACID properties, consistency model, storage model, cascading rollback, recoverable schedules. Concurrency: Schedules, testing for serializability, Lock-based protocols-Two-phase locking protocol, Timestamp based protocol, optimistic techniques, deadlock handling. Recovery: Failure classification, storage hierarchy, log-based recovery, shadow paging. Query processing and optimization: Steps of query processing, query interpretation, equivalence of expression, estimation of cost, join strategies

Distributed Database: Principles of distributed database, levels of distribution transparency, data fragmentation, replication and allocation techniques.

Data warehousing: Basic Concepts, OLTP, Advantages and Drawbacks of Data Warehouse, Data Warehouse Architecture. Data Warehouse Schema: Star, Snowflake, Fact Constellation. Data Marts: Basic concepts, Advantages and drawbacks, Components. Data Warehouse Design: Different views of designs, processes of design. On-line Analytical Processing: Concepts of OLAP, Multidimensional Data Model; OLAP Operations.

LAB: Advanced Database Management System and Data Warehousing (40 marks)

Books and References:

1. Elmasri, Navathe, Fundamentals of Database System, 3/e, Pearson Education.
2. Korth, Silberschatz : Database System Concepts, McGrawHill ,
3. Ceri and Pelagatti, Distributed Databases: Principles and System: McGrawHill
4. "Data Mining: Concepts and techniques", J Han and M Kamber, Third Edition, Elsevier.

CMSM Core 3 Composite - MCMS 4113

Advanced Operating System (Theory – 60 marks)

Introduction to distributed Systems: Definition, goals, Advantages– Disadvantages, Hardware and Software concepts, Design issues.

Synchronization in distributed systems: Clock synchronization and related algorithms, mutual exclusion, Deadlock in distributed systems.

Distributed File Systems: Introduction, features & goal of distributed file system, file models, file accessing models, file sharing semantics.

Distributed Shared Memory: Introduction, general architecture of DSM systems, design and implementation issues of DSM, different protocols of DSM. Naming Overview, Features, Basic concepts, System oriented names, Object locating mechanisms.

Communication in Distributed System: Computer Network and Layered protocols, Message passing and related issues, synchronization, Client Server model & its implementation, remote procedure call and implementation issues, Case Studies: SUN RPC.

Processes and processors in distributed systems: Threads, system model, processor allocation, scheduling in distributed systems: Load balancing and sharing approach, fault tolerance, Real time distributed systems, Process migration and related issues

Distributed Web-based Systems Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication: Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications

Case Study Java RMI.

LAB: Advanced Operating System (40 marks)

Books and References:

1. Tanenbum,A.S.,Distributed Operating Systems ,Pearson Education.
2. Singhal,Shivaratri,Advanced Concepts in Operating Systems,TMH.
3. P.K.Sinha,Distributed Operating Systems,PHI

CMSM4 Core 4 Theory - MCMS 4104

Advanced Computer Architecture (Theory – 100 marks)

Introduction: Elements of Modern Computers, Performance, The Switch from Uniprocessors to Multiprocessors

Parallel Processing: Parallel Computer Structures, Architectural Classification, Parallel Processing Applications

Principles of Pipelining and Vector Processing: Pipelining, Instruction and Arithmetic Pipelines, Principles of designing pipelined processors, vector processing requirements

Structures and Algorithms of Array Processors (SIMD Computers): SIMD Array Processors, SIMD Interconnection networks, Parallel Algorithms for Array Processors

Multiprocessor Architecture and Programming: Functional Structures, Interconnection Networks, Multistage Interconnection Networks, Parallel Memory Organizations

Memory and I/O sub-systems: Hierarchical Memory Structures, Cache Memories and Management, I/O sub-systems

Books and References:

1. Kai Hwang, Advanced Computer Architecture, Tata Mc Graw Hills
2. Kai Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, Tata Mc Graw Hills
3. Hennessy Patterson, Computer Architecture, A quantitative Approach , 5th ed, Elsevier.
4. Dongarra, Foster, Fox & others, Source Book of parallel Computing, Elsevier.
5. M.J Quinn, Designing Efficient Algorithms for Parallel Computers, Mc Graw Hill

CMSM Core 5 Composite - MCMS 4211

Microcontroller and Embedded Systems (Theory – 60 marks)

Introduction to embedded systems, definition of embedded system, classification of embedded systems, Overview of Embedded System Architecture, skills required for an embedded system designer, processor in the system, memories and I/O Interfaces, Linking and interfacing buses (GPIB(IEEE 488)) Link, software embedded into a system, Real Time O.S. & embedded system, embedded system on-chip(SOC) and in VLSI circuit. Application areas (exemplary cases). Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM and DSP.

Introduction to Microprocessors, Microcontrollers and Embedded Processors, Microcontrollers survey-four bit, eight bit, sixteen bit, thirty two bit Microcontrollers, Comparing Microprocessors and Microcontrollers-Overview of the 8051 family.

The 8051 Architecture, Hardware, Oscillator and clock-program counter, data pointer, registers, stack and stack pointer, special function registers, memory organization, program memory, data memory, Input / Output Ports, External memory counter and timer-serial data Input / output-Interrupts.

8051 Assembly Language Programming, Structure of Assembly language Assembling and running an 8051 program- Addressing modes, accessing memory using various addressing modes, Instruction set, Arithmetic operations and Programs, Logical operations and programs, Jump and Call instructions and Programs -I /O Port, Single bit instructions, Timer and counter, delay Programs.

8051 Serial Communication, Serial Communication Programming, Interrupts Programming.

Microcontroller Interfacing, Peripherals: Keyboard, Displays, Basic concept of PIC microcontroller, PIC16F Family.

LAB: Microcontroller and Embedded Systems (40 marks)

Books and References:

1. Ray, Bhurchandi ,Advanced Microprocessors and Peripherals, Tata Mc Graw Hill.
2. Mazidi, McKinlay, The 8051 Microcontroller and Embedded

CMSM Core 6 Theory - MCMS 4202

Advanced Computer Networks (Theory – 100 marks)

Network Architecture: Layered architecture and protocol hierarchy TCP/IP protocol suite, Services and important functions of each layer

Local Area Networks: Aloha and Carrier Sense Protocols, Ethernet, Token Ring, FDDI

Connecting Devices: Bridges, Backbone Networks, Virtual LAN

Internetworking: Virtual Circuits and datagrams, IP addressing, IPv4 and IPv6 datagrams, Subnetting, CIDR

Routing Algorithms: Shortest path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast and Multicast Routing, Routing for mobile hosts

Routing Protocols: ARP, RARP, ICMP, RIP, OSPF, BGP

Process to Process Delivery: TCP and UDP

Congestion Control and Quality of Service: Congestion control Techniques, Congestion control in TCP. Techniques for improving the QoS

Application Layer: An overall idea of socket and DNS; Detailed working principles of two application layer protocols - SNMP and SMTP

Wireless LAN: IEEE Standards for Wireless Networks Wireless Networks Applications, Types of Wireless Networks, Benefits of Wireless Networks, Bluetooth – Architecture and Protocol Stack

Software Defined Networks (SDN): Definition, Layers and Applications

Books and References:

1. B.Forouzan – Data Communication and Networking.TMH
2. A Tanenbaum – Computer Networks, PHI
3. Computer Networks by Behrouz A. Forouzan
4. TCP/IP Protocol Suite by Behrouz A. Forouzan

CMSM Core 7 Theory - MCMS 4203

Compiler Design (Theory – 100 marks)

Review: Concepts and Types of Translators: Assembler, Cross-Assembler, Pre-Processor, Interpreter, Simulator, Loader; Linker.

Grammars, Languages – types of grammars and their recognizers, Basic concepts of translators: boot strapping, cross compiler, Different phases of compilation.

Lexical analyzer: Concepts, Tokens, Schemas, Design using FSM.

Syntax Analysis: Top down and Bottom-up parser; Operator precedence; Recursive descent; LL (1); LR (1);LALR (1).

Intermediate code generation: Three Address Code, Representation of three address code – Quadruples, Triples and Indirect Triples.

Syntax directed translation: Attributes, Semantic Actions, Translation schemes.

Code Optimization: Basic blocks, loop optimization, flow graph, DAG representations of basic blocks.

Code generation: Object Programs, Problems in Code Generation.

Error handling: detection, reporting, recovery and repair

Symbol tables: Organization and management techniques.

Runtime storage management: static allocation; dynamic allocation, activation records; heap allocation, recursive procedures

Books and References:

1. Alfred V. Aho and Jeffrey D. Ullman, Principles of Compiler Design, Narossa Publication
2. Aho, Sethi and Ullman, Compilers – Principles, Techniques and Tools, Narossa Publication
3. Peter Linz, Formal Language and Automata Theory, Narossa Publication
4. Systems Programming and Operating System, D. M. Dhamdhere, Tata McGraw Hills
5. Systems Programming, John J Donovan, Tata McGraw Hills

CMSM4 Core 8 Practical - MCMS 4254

Internet Technologies (Practical – 100 marks)

HTML Preview, Forms: elements, attributes, actions and methods.

CSS (Cascading Style Sheets) -Introduction, Benefits of CSS, CSS Syntax, Value Lengths and Percentages, Internal Style sheets, Inline and External Style sheets. CSS2-Selectors: ID Selectors, Class Selectors, Grouping Selectors, Descendant / Child Selectors, Attribute Selectors, CSS - Pseudo Classes CSS2- Color, Background and Cursor: background-image, background-repeat, background-position, linear and radial gradient, CSS Cursor CSS2-Text Fonts: color, background-color, text-decoration, text-align, vertical-align, text-indent, text-transform, letter-spacing, word-spacing, line-height, font-family, font-size, font-style, font-variant, font-weight. CSS2-Lists and Tables: list-style-position, list-style-image, list-style, CSS Tables. CSS2-Box Model: Borders & Outline, Margin & Padding, Height and width, CSS Dimensions. CSS2-Display Positioning and Floats: CSS Visibility, CSS Display, CSS Scrollbars, CSS Positioning (Static Positioning, Fixed Positioning, Relative Positioning, Absolute Positioning), Float property, Clear Property, Advanced CSS: CSS Images, Responsive CSS, CSS Effects, CSS Animations, CSS Media, CSS Slideshows.

Java Script: Introduction in JS, DOM (Document Object Model), Function Call and return statements in JavaScript, Form Handling and Applications using JS.

PHP: PHP introduction, important tools and software requirements (like Web Server, Database, and Editors). scope of PHP – Basic Syntax, PHP variables and constants. Types of data in PHP, Expressions, scopes of a variable (local, global), PHP Operators. Handling HTML form with PHP: Capturing Form Data, GET and POST form methods, Dealing with multi value fields. Redirecting a form after submission. PHP conditional events and Loops: PHP IF Else conditional statements (Nested IF and Else), Switch case, while, For and Do While Loop Break, Continue and exit. PHP Functions: Need of Function, declaration and calling of a function PHP Function with arguments, Function argument with call by value, call by reference Scope of Function Global and Local. PHP String Manipulation: Creating and accessing String, Searching & Replacing String Formatting, joining and splitting String, String Related Library functions. Use of different string functions like strlen(), strrev(), strpos(), split() etc. PHP Arrays: Anatomy of an Array, creating index based and Associative array, Accessing array. Looping with Index based array, with associative array using each () and foreach (), Sorting Arrays. PHP Advanced Topics: PHP Date and Time, Browser and system configurations, Database connection and handling records using PHP and using MySQL.

JSP: MVC (Model View Controller Architecture) JSP scripting elements, Servlets, JSP vs Servlets

Introduction to **WordPress**

CMSM Core 9 Composite

SOFTWARE ENGINEERING and DESIGN (Theory – 60 marks)

Software Engineering Fundamentals: Nature of Software; Software Application Domains, Legacy Software, Changing Nature of Software: WebApps, Mobile Applications, Cloud Computing, Product Line Software; Software Process.

Software Requirements Analysis; Requirements engineering: Functional and non-functional requirements, Software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Software Design: The Design Process, Software Quality Guidelines and Attributes, Design Concepts: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring; Object-Oriented Design Concepts, Design Classes; Design Model and Design Elements.

Effort Estimation: Function Points, COCOMO, Project scheduling and staffing

Software Testing: Strategy and Environment, Building Software Testing Process, Types of Software Testing, Black Box and White Box Software Testing Techniques, Software Testing Life Cycle, Software Testing Tools.

Software Process and Project Management: Process Reference Models, Workflows and Checkpoints of process, Process Planning, Project Organizations, Project Control and process instrumentation.

Software Quality Assurance and Testing: Software Quality Assurance and Standards, Quality Standards, SERVQUAL, Software Process Maturity.

Component-based Software Development: Component definition, Planning Team Roles for CBD, The Design of Software Component Infrastructures - Software Components and the UML, Component Technologies.

LAB: SOFTWARE ENGINEERING (40 marks)

Books and References:

1. Roger S. Pressman, Software Engineering - A Practitioner's Approach, McGraw- Hill
2. Somerville, Software Engineering, Pearson Education

CMSM Core 10 Composite

ARTIFICIAL INTELLIGENCE (Theory – 60 marks)

Introduction: AI applications, AI techniques, AI Problems. Importance of AI

State Space search: State Space Graphs, Implicit and explicit graphs, Production Systems, formulating the state-space; Uninformed search: breadth first search, depth first search; Uniform cost algorithm; Informed search: use of heuristics, problem characteristics and applications

Intelligent Agents: What is an agent? Intelligent Agents; Multi agent systems; Applications; The downside.

Heuristic Search Techniques: Generate and Test, hill climbing, simulated annealing, Best first search, A* algorithm, Agenda driven search, Problem Reduction, AO* algorithm, Constraint satisfaction, Means end analysis.

Game Playing: Minmax and game trees, refining minmax, Alpha – Beta pruning.

Knowledge Representation: First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies.

Uncertainty: different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, other approaches to modelling uncertainty such as Dempster-Shafer theory and fuzzy sets/logic.

Learning: Rote learning, learning by taking advice, learning by problem solving, learning by examples.

Natural language processing: component steps of communication, contrast between formal and natural languages in the context of grammar, parsing, and semantics

LAB: ARTIFICIAL INTELLIGENCE(40 marks)

Books and References:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 2006.
2. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill, 2002.
3. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers , Inc., San Francisco, California, 2000.
4. R. Akerkar, Introduction to Artificial Intelligence, Prentice-Hall of India, 2005

5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, 2006.
6. Nils J. Nilson, Principles of Artificial Intelligence, Narosa Publishing House, 2001
7. W.F. Clocksin and C.S. Mellish, Programming in PROLOG, Narosa Publishing House, 2002.
8. Ivan Bratko, Prolog Programming for Artificial Intelligence, Pearson, 2018.

CMSM Core 11 Theory

Module 1: VLSI Design (Theory – 100 marks)

Introduction to VLSI systems: Overview of VLSI technology, Fabrication and Layout of CMOS (Fabrication Process Flow, CMOS n-Well Process, Layout & Design Rules, CMOS inverter Layout Design), IC production process & Packaging, MOS Transistors, Combinational and sequential circuit design, Static and dynamic CMOS gates.

VLSI automation Algorithms for Physical Design

Partitioning: problem formulation, classification of partitioning algorithms, Group migration algorithms, Kernighan – Lin Heuristics.

Floor planning & pin assignment: problem formulation, placement and floor planning, floor planning algorithms for mixed block & cell design, Floor planning based on Simulated

Annealing and Simulated Evolution.

Global Routing: Global Routing between blocks, classification of global routing algorithms, Maze routing algorithm, line probe algorithm.

Detailed routing: Problem formulation, classification of routing algorithms, single layer routing algorithms, constrained & unconstrained via minimization.

Testing : Introduction to different types of testing.

Introduction to digital design using VHDL.

MODULE 2: Internet of Things (50 marks)

Introduction to Internet of Things: Application areas of IoT, Characteristics of IoT, Things in IoT, IoT stack, Enabling technologies, IoT challenges, IoT levels, IoT and cyber physical system, IoT and WSN, Microcontrollers, and Their Interfacing: Sensor interfacing, Types of sensors, Controlling sensors, Microcontrollers, ARM

Protocols for IoT: Messaging protocols, Transport protocols, IPv4, IPv6, URI

Cloud for IoT: IoT and cloud, Fog computing, Security in cloud, Case study

Application Building with IoT: Various application of IoT

Arduino and Raspberry Pi: Architecture, Programming and Application.

IoT Security: Various security issues and need, architecture, requirement, challenges and algorithms

Books and References:

1. Neil H. E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, 2nd edition, Pearson Education Asia, 2000.
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley and Sons, Inc., 2002.
3. Samir Palnitkar, Verilog HDL, 2nd Edition, Pearson Education, 2004.
4. Debaprasad Das, VLSI Design, Oxford University Press, 2010
5. Christophn Meinel & Thorsten Theobold, "Algorithm and Data Structures for VLSI Design", KAP, 2002.
6. Rolf Drechsheler : "Evolutionary Algorithm for VLSI", Second edition.
7. Internet of Things, Vasudevan, Nagrajan and Sundaram, Wiley India
8. IoT Fundamentals, David Hence at el, Cisco Press
9. 21 IoT Experiments, Yashavant Kanetkar, Shrirang Korde, BPB
10. IoT Based Projects, Rajesh Singh at el, BPB
11. Internet of Things with ARDUINO and BOLT, Ashwin Pajankar, BPB
12. Star Expert IoT Specialist, STAR CERTIFICATION

Discipline Specific Elective (100)

CMSM DSE 1 Composite

Digital Image Processing (Theory – 60 marks)

Introduction: Introduction of Image Processing with its applications, Components of Image processing system, Image, Formation model. Image digitization process.

Spatial Domain Image Transformation: Introduction of Image enhancement, Image enhancement techniques: Contrast intensification by Linear stretching, Non-Linear stretching, Exponential stretching, Noise cleaning or Smoothing by Image averaging, Image sharpening.

Frequency Domain Image Transformation: Basic transformations in the frequency domain, Low Pass and High Pass Filters (Gaussian, Butterworth, Laplacian)

Colour Image Processing: Pseudo and False colouring, Image fusion. Colour Models: RGB, CMY, HSI

Image Compression: Introduction, Lossy Compression techniques and Loss less image compression techniques, Huffman coding, Run Length Encoding, JPEG, Block Truncation compression.

Image Pattern Representation and Recognition: Representation, Boundary Descriptors, Regional Descriptors, Patterns and Pattern Classes, Recognition based on decision theoretic methods, structural methods

LAB: Digital Image Processing(40 marks)

Books and References:

1. Gonzalez E. Woods, Digital Image Processing, Pearson Education
2. Digital Image Processing and Pattern Recognition, Malay K. Pakhira, PHI
3. Arthur Weeks, Fundamentals of Electronic Image Processing, PHI

CMSM DSE 2 Composite

Foundations of Data Science (Theory – 60 marks)

Introduction to Data Science: Data Science Lifecycle; Pre-requisites of Data Science; Role of Data Science and Data Scientist; Stages in a Data Science Project; Applications of Data Science; Data Security Issues.

Dealing with Big Data: Big Data and Cloud technologies ; Introduction to HADOOP; Big Data, Apache Hadoop, MapReduce; Data Serialization; Data Extraction; Stacking Data; Dealing with data.

Exploratory Data Analysis (EDA): Statistical Measures, Basic tools of EDA, Discovery. Basic Functionalities of a data object; Merging of Data objects; Concatenation of data objects; Types of Joins on data objects; Exploring a Dataset; Analysing a dataset; Group By operations; Aggregation; Concatenation; Merging ; Joining.

Statistics and Probability Distributions: Data collection and classification; Graphical representation; Measures of central tendency and dispersion; Moments, Skewness, Kurtosis; Theory of Probability; Random Variable: Discrete and Continuous Probability Distributions, Joint Distributions; Theoretical Distributions: Binomial, Poisson and Normal; Sampling Theory; Hypothesis Testing.

Correlation and Regression: Curve fitting, Method of Least Squares and their application for various types of curves; Scatter Diagram; Correlation; Standard Error; Linear regression; Multiple Regression; Rank Correlation.

Basics of Linear Algebra: Vectors: Linear dependence and independence; Eigen Values and Eigen Vectors: properties; Caley-Hamilton theorem and its application; Reduction to Diagonal form; Quadratic form and their nature; Principal axes form.

Learning techniques: Supervised learning; Unsupervised learning; Modelling Process; Training, Validating and Testing; Overview of Deep Learning.

LAB: Foundations of Data Science (40 marks)

Books and References

1. Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
2. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013.
4. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.
5. Ethem Alpaydin, "Introduction to Machine Learning". MIT Press. 2020.

CMSM DSE 3 Theory

SOFT COMPUTING (Theory – 100 marks)

Introduction to Soft Computing: Concept of computing systems, Characteristics of Soft computing. Introduction to Computational Intelligence, Computational Intelligence Paradigms.

Evolutionary Computation: Genetic Algorithm - Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc.

Swarm Intelligence: Particle Swarm Optimization; Ant Algorithms; Artificial Bee Colony Optimization; Applications.

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inference, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems.

Optimization: Introduction, Optimization Problem Classifications, Optima Types, Unconstrained Optimization, Constrained Optimization, Single and Multi-objective Optimization Problem Solving, Multi-Objective Evolutionary Algorithm, Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs. Applications.

Overfitting and Regularization: Introduction to overfitting, regularization and its application, Introduction to cross-validation, use of cross-validation to identify the optimal parameters.

Books and References

1. Genetic Algorithms in Search, Optimization, and Machine Learning, David E. Goldberg, Addison Wesley.
2. Multi-Objective Optimization Using Evolutionary Algorithms, Kalyanmoy Deb, John Wiley and Sons
3. Computational Intelligence - An Introduction, Second Edition, Andries P. Engelbrecht, John Wiley & Sons Inc
4. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
5. Soft Computing, D. K. Pratihar, Narosa, 2008.
6. Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.

CMSM DSE 4 Composite

Machine Learning and Data Mining (Theory – 60 marks)

Introduction to Data Mining: Architecture of a Data Mining System; KDD Vs Data Mining; Applications of Data Mining.

Data Preprocessing: Overview; Data cleaning; Data Integration; Data Reduction.

Mining Frequent Patterns and Association: Frequent itemsets, Closed itemsets, Association rules; Apriori algorithm, Hash based technique.

Introduction to Machine Learning: Definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation

Regression: Linear regression; Logistic regression; Polynomial regression; Applications.

Classification: Supervised learning; Support Vector Machine, Decision Tree, Random Forest, Naive Bayes classifier; Rule based classification, Model evaluation and selection, Confusion matrix, Accuracy, Recall, Precision, F1 score, ROC, AUC.

Clustering: Unsupervised learning, Partitioning methods; Hierarchical methods; Density based methods.

Neural Network: Introduction and Features, Least Mean Square algorithm, Perceptron, Backpropagation, Multilayer network, Introduction to Deep Learning.

Books and References:

1. “Data Mining: Concepts and techniques”, J Han and M Kamber, Third Edition, Elsevier.
2. “The Top Ten algorithms in Data Mining”, CRC Press.
3. Ethem Alpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.
4. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.

CMSM DSE 5 Theory

Mobile Communications (Theory – 100 marks)

Introduction: Advantages and disadvantages, evolution, special considerations for node mobility;

Wireless transmission: Frequency band for signal transmission, signal propagation, multiplexing, modulation, spread spectrum, cellular systems;

Medium Access Control: Motivation for a specialised MAC, SDMA, TDMA, FDMA, CDMA;

Telecommunication systems: GSM architecture and protocol suite in details;

Wireless LAN: Infrastructure and ad-hoc network, IEEE 802.11 – PCF, DCF, frame format, services (association, authentication, etc.), Bluetooth – different profiles, introduction to its protocol stacks;

Mobile Network Layer: Mobile IP, DHCP, Mobile Ad-hoc networks;

Mobile Transport Layer: mobility and effects on transport protocols; TCP performance on wireless links – possible improvement; Management issues in mobile/ wireless environment: Location determination & management, mobility management, power management;

Mobile/Wireless applications: WAP, WML, mobile file access;

Security: Introduction to special security issues in mobile/wireless environment, notion of WEP;

Books and References:

1. Jochen Schiller, Mobile Communication, Pearson Education
2. Stallings, Wireless Communication, Pearson Education

Discipline Specific Elective (50)

DSE 6 Theory

Ecommerce (Theory – 50 marks)

Introduction to ecommerce: Meaning and concept of ecommerce, ecommerce vs e-business, advantages and disadvantages of ecommerce, E-Business vs the Traditional Business Mechanism, competitive advantage and competitive strategy, main goals of e-commerce, different types of ecommerce like B2B, B2C, C2C, C2B, G2C. Revenue Models of e-commerce (Advertising Revenue Model, Sales Revenue Model, Subscription based Revenue Model, Referral fee Revenue Model, Pay per Click Revenue Model),

Technology in ecommerce: An overview of the internet, basic network architecture and the layered model, internet architecture, network hardware and software considerations, intranets and extranets. The making of world wide web (WWW), web system architecture, ISP, URL, URI, URN. cookies. Types of Servers (Web, Database, Mail, File), Protocol (http, https, ftp), WWW, URL. Designing, building and launching e-commerce website choosing an ISP, registering a domain name, outsourcing vs. in-house development of a website, internet marketing techniques, personalization, Overview of M-Commerce - Wireless Application Protocol (WAP)

Security threats: Security in cyberspace, Security threats in the E-commerce environment – malicious codes (virus, Trojan, worm), Cyber-crimes. Basic cryptography for enabling security in ecommerce: encryption: public and private key encryption, internet security using VPN, firewalls, SSL. IT Act 2000, 2008: Objectives, Definitions, Electronic governance, Regulation of certifying authorities, Digital signatures and certificates. Ethical issues, legal issues, taxation issues and international issues in e-commerce.

Internet payment systems and e-marketing: E-Payment System: Different methods of e-payment (Debit Card, Credit Card, Smart Cards, e-money, digital wallet), Working of payment gateway, Internet Banking. SET protocol for credit card payment. Cryptocurrency. E-Marketing: Concept, types of e-marketing, means of advertising: e-branding, SEO-Basics

Introduction to ERP and E-CRM: Introduction to ERP: Concept & definition, features, major characteristics, levels of ERP, Benefits of ERP, Enterprise potentials of ERP, Modules of ERP, Phases of ERP implementation, Limitations of ERP. E-CRM Concept & definition, features, Goals of E-CRM business framework, Three phases of ECRM, Types of E-CRM, Functional Components.

Client/Server Computing: Client Server architecture, mainframe-centric client server computing, downsizing and client server computing, preserving mainframe applications, client server development tools, advantages of client server computing. Components of Client/Server application: The client: services, request for services, RPC, windows services, fax, print services, remote boot services, other remote services, Dynamic Data Exchange (DDE), Object Linking and Embedding (OLE), Common Object Request Broker Architecture (CORBA). The server: Detailed server functionality, the network operating system, available platforms, the network operating system, available platform, the server operating system. RAID, RAID-Disk network interface cards

Books and References:

1. E-commerce, business, technology, society, Kenneth Laudon & Traver, Pearson Education
2. Information Technology for Management, Ramesh Behl, McGraw Hill
3. E-Commerce Strategy, Technologies and Applications, David Whiteley, McGraw Hill
4. E Commerce - An Indian Perspective by P.T.Joseph, PHI
5. ERP DEMYSTIFIED: Alexis Leon, Tata Mc Graw Hill

DSE 7 Theory

Cloud Computing (Theory – 50 marks)

Cloud Computing Basics: Overview - Definition, Characteristics, Advantages, Disadvantages

Cloud Deployment Models: Public Cloud Model, Private Cloud Model, Hybrid Cloud Model, Community Cloud Model

Cloud Technologies: Virtualization, Service-Oriented Architecture (SOA), Grid Computing, Utility Computing

Cloud Computing Architecture: Front-End and Back-End, Management Software, Deployment Software, Network, Server, Storage

Cloud Service Models: Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service, Identity-as-a-Service, Network-as-a-Service

Cloud Solutions: Microsoft, Google, Amazon Web Service (AWS), Cisco, IBM (features, deployment, advantages and limitations)

Virtualization: Need for virtualization, Types of hardware virtualization, Desktop virtualization, Server Virtualization, Hypervisor, Virtual machines, Virtualization Solutions, Concept of load balancing, High Availability (HA) in virtualization environment, Virtualization Tools - VMWARE, Oracle Virtualbox

Cloud Security: Planning, Access Control, Auditing, Authentication, Authorization, Encryption, File encryption, Secure communications, Web application firewall, Data center security, Data center availability, Regular backups, Professional best practices, CSA stack model, Brokered Cloud Storage Access

Books and References:

- Cloud Computing: Concepts, Technology & Architecture (The Pearson Service Technology Series from Thomas Erl) by Thomas Erl, Ricardo Puttini, Zaigham Mahmood
- Handbook of Cloud Computing: Basic to Advance research on the concepts and design of Cloud Computing 1st Edition by Anand Nayyar, BPB Publications
- Cloud Computing Black Book, by Kailash Jayaswal, Jagannath
- Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill

DSE 8 Theory

Information Security and Cyber Law (Theory – 50 marks)

Information Security: Introduction, Need of Information Security, Attributes of Information Security, Authentication, Confidentiality, Integrity, Availability, Non Repudiation. Security Services, mechanism and attacks, Access Control, Threats and Vulnerabilities, Security Attacks, Unauthorized Access, Impersonation, Denial of Service, Malicious Software, Viruses, Worms, Trojan Horses. Types of authentication, Password Authentication,

Password Vulnerabilities & Attacks: Brute Force & Dictionary Attacks. Password Policy & Discipline, Single Sign-on – Kerberos, Alternate Approaches.

Intellectual Property Right: Introduction, Types of Intellectual Property Rights, Advantages of Intellectual Property Rights, Intellectual Property Rights in India, Intellectual Property in Cyber Space, Plagiarism

Strategies For Cyber Security: Introduction, Creating a Secure Cyber Ecosystem, Creating an Assurance Framework, Strengthening the Regulatory Framework, Creating Mechanisms for IT Security, Securing E-Governance Services, Protecting Critical Information Infrastructure. Implementing a Cyber security Framework, Types of Network Security Devices, Threat Intelligence, Next Generation Firewall, Secured Protocol and Algorithms, Authentication Techniques, BYOD, Cloud and Mobile Security, Cyber Forensics, Information Sharing

Cyber Law: Cyberspace, Cyber security, Cyber security Policy, Cyber Crime, Nature of Threat, Awareness, Information Technology Act, Objectives, Digital Signature, Electronic Signature, Digital Signature to Electronic Signature. Offence & Penalties: Cybercrime, Categories of Cybercrimes, Types of Cybercrimes, Offences, Compounding of Offences.

I.T ACT: Salient Features of I.T Act, Scheme of I.T Act, Application of the I.T Act, Amendments Brought in the I.T Act, Intermediary Liability, Highlights of the Amended Act Impact on other related Acts (Amendments): Amendments to Indian Penal Code, Amendments to Indian Evidence Act, Amendments to Bankers Book Evidence Act, Amendments to Reserve Bank of India Act.

Books and References:

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. The Information Technology Act, 2000 (Act 21 of 2000), BARE ACT with Comments, Law and Justice Publishing Co, 2021.
3. Fundamentals Of Information Systems Security, David Kim, Michael G. Solomon
Cybersecurity and Cyberlaw, Abraham Wagner, Nicholas Rostow

Interdisciplinary Elective (50)

IDE 1 Theory

Information Security and Cyber Law (Theory – 50 marks)

Information Security: Introduction, Need of Information Security, Attributes of Information Security, Authentication, Confidentiality, Integrity, Availability, Non Repudiation. Security Services, mechanism and attacks, Access Control, Threats and Vulnerabilities, Security Attacks, Unauthorized Access, Impersonation, Denial of Service, Malicious Software, Viruses, Worms, Trojan Horses. Types of authentication, Password Authentication,

Password Vulnerabilities & Attacks: Brute Force & Dictionary Attacks. Password Policy & Discipline, Single Sign-on – Kerberos, Alternate Approaches.

Intellectual Property Right: Introduction, Types of Intellectual Property Rights, Advantages of Intellectual Property Rights, Intellectual Property Rights in India, Intellectual Property in Cyber Space, Plagiarism

Strategies For Cyber Security: Introduction, Creating a Secure Cyber Ecosystem, Creating an Assurance Framework, Strengthening the Regulatory Framework, Creating Mechanisms for IT Security, Securing E-Governance Services, Protecting Critical Information Infrastructure. Implementing a Cyber security Framework, Types of Network Security Devices, Threat Intelligence, Next Generation Firewall, Secured Protocol and Algorithms, Authentication Techniques, BYOD, Cloud and Mobile Security, Cyber Forensics, Information Sharing

Cyber Law: Cyberspace, Cyber security, Cyber security Policy, Cyber Crime, Nature of Threat, Awareness, Information Technology Act, Objectives, Digital Signature, Electronic Signature, Digital Signature to Electronic Signature. Offence & Penalties: Cybercrime, Categories of Cybercrimes, Types of Cybercrimes, Offences, Compounding of Offences.

I.T ACT: Salient Features of I.T Act, Scheme of I.T Act, Application of the I.T Act, Amendments Brought in the I.T Act, Intermediary Liability, Highlights of the Amended Act Impact on other related Acts (Amendments): Amendments to Indian Penal Code, Amendments to Indian Evidence Act, Amendments to Bankers Book Evidence Act, Amendments to Reserve Bank of India Act.

Books and References:

Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
The Information Technology Act, 200 (Act 21 of 2000), BARE ACT with Comments, Law and Justice Publishing Co, 2021.

Fundamentals Of Information Systems Security, David Kim, Michael G. Solomon
Cybersecurity and Cyberlaw, Abraham Wagner, Nicholas Rostow

IDE 2 Theory

Internet of Things (Theory – 50 marks)

Introduction to Internet of Things: Application areas of IoT, Characteristics of IoT, Things in IoT, IoT stack, Enabling technologies, IoT challenges, IoT levels, IoT and cyber physical system, IoT and WSN

Sensors, Microcontrollers, and Their Interfacing: Sensor interfacing, Types of sensors, Controlling sensors, Microcontrollers, ARM

Protocols for IoT: Messaging protocols, Transport protocols, IPv4, IPv6, URI

Cloud for IoT: IoT and cloud, Fog computing, Security in cloud, Case study

Application Building with IoT: Various application of IoT

Arduino and Raspberry Pi: Arduino : Architecture, Programming and Application, Raspberry Pi : Architecture, Programming and Application

IoT Security: Various security issues and need, architecture, requirement, challenges and algorithms

Books and References:

1. Internet of Things, Vasudevan, Nagrajan and Sundaram, Wiley India
2. IoT Fundamentals, David Hence at el, Cisco Press
3. 21 IoT Experiments, Yashavant Kanetkar, Shrirang Korde, BPB
4. IoT Based Projects, Rajesh Singh at el, BPB
5. Internet of Things with ARDUINO and BOLT, Ashwin Pajankar, BPB
6. Star Expert IoT Specialist, STAR CERTIFICATION