SCHEME OF EXAMINATION
AND
COURSE OF STUDY

for

MASTER OF COMPUTER APPLICATIONS (MCA)
(Full- Time Two Years Course)

Under

Choice Based Credit System

(*w.e.f. Session 2020-- 21*)

DEPARTMENT OF COMPUTER SCIENCE

FACULTY OF TECHNOLOGY

GURUKULA KANGRI VISHWAVIDYALAYA HARIDWAR

(***Deemed to be university u/s 3 of UGC Act 1956***)

JUNE 2020

SCHEME OF EXAMINATION
MASTER OF COMPUTER APPLICATIONS (MCA)

Paper Code	Paper Title	Periods Per Week				Evaluation Scheme		
		L	T	P	C	CIA	ESE	Total
SEMESTER - I								
MCA-C101	Programming Fundamentals and C Language	4	0	0	4	30	70	100
MCA-C102	Software Engineering	4	0	0	4	30	70	100
MCA-C103	Computer System Architecture	3	1	0	4	30	70	100
MCA-C104	Mathematical Foundations for Computer Science	3	1	0	4	30	70	100
MCA-C105	Database Management System	4	0	0	4	30	70	100
MCA-C106	Operating Systems	4	0	0	4	30	70	100
MCA-C151	DBMS Lab	0	0	4	2	30	70	100
MCA-C152	C on Linux Lab	0	0	4	2	30	70	100
TOTAL		22	2	8	28			800
SEMESTER - II								
MCA-C201	Data Structures	4	0	0	4	30	70	100
MCA-C202	Computer Networks	3	1	0	4	30	70	100
MCA-C203	Theory of Computer Science	3	1	0	4	30	70	100
MCA-C204	Object Oriented Technology	4	0	0	4	30	70	100
MCA-O205	Online Course	4	0	0	4	-	-	-
MCA-E20X	Elective -I	4	0	0	4	30	70	100
MCA-C251	Data Structures Lab	0	0	4	2	30	70	100
MCA-C252	OOP Lab	0	0	4	2	30	70	100
TOTAL		22	2	8	28			700
SEMESTER - III								
MCA-C301	Machine Learning	4	0	0	4	30	70	100
MCA-C302	Cyber Security	4	0	0	4	30	70	100
MCA-C303	Cloud Computing	4	0	0	4	30	70	100
MCA-C304	Design and Analysis of Algorithms	4	0	0	4	30	70	100
MCA-O305	Online Course	4	0	0	4	-	-	-
MCA-E30X	ELECTIVE – II	4	0	0	4	30	70	100
MCA-C351	Python Programming Lab	0	0	6	3	30	70	100
MCA-C352	Web Technologies Lab	0	0	6	3	30	70	100
TOTAL		24	0	12	30			700
SEMESTER - IV								
MCA-C451	Major Project	0	0	40	20			400
GRAND TOTAL					106			2600
CIA: Continuous Internal Assessment						ESE: End Semester Examination		

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LIST OF ELECTIVES

Elective - I	
MCA-E206	Computer Graphics
MCA-E207	Digital Image Processing
MCA-E208	Graph Theory
Elective- II	
MCA-E306	Big Data Analytics
MCA-E307	Internet of Things
MCA-E308	Android Application Development
MCA-E309	Soft Computing
MCA-E310	Remote Sensing and GIS
MCA-E311	Compiler Design
MCA-E312	Data Science

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MCA- C101 Programming Fundamentals and C Language				
	L	T	P	C
	4	0	0	4

Course objective:

1. To learn the fundamentals of computers, problem solving techniques by writing algorithms and procedures.
2. To learn the syntax and semantics of C programming language.

Course outcomes:

1. Ability to write algorithms for problems.
2. Ability to code a given logic in C language.

Fundamentals: Classification of Computers, Application of Computers, Basic organization of computer, Input and Output Devices, Binary Number System, Computer memory, Computer Software. Algorithm, Generation of Programming Languages.

Introduction to 'C' programming: Fundamentals, Structure of a 'C' program, Compilation and linking processes.

Expressions and Console I/O: Basic Data types, Identifier Names, Variables, Scope, Type qualifiers, Storage class specifiers, Constants, Operators, Reading and writing characters, Reading and writing strings, Formatted and console I/O, printf(), scanf(), Suppressing input.

Statements: True and False in C, Selection statements, Iteration statements, Jump statements, Expression statements, Block statements.

Arrays and Strings: Single dimensional array, Two-dimensional array, Strings, Array of strings, Multi-dimension array, Variable length arrays.

Pointers: Pointer variables, Pointer operators, Pointer expressions, Pointers and arrays, Multiple indirection, Pointer initialization, Pointers to arrays, Dynamically allocated arrays, Problems with pointers.

Functions: General form of a function, understanding scope of a function, Function arguments, Command line arguments, Return statement, Recursion, Function prototype, Pointers to functions.

Structures, Unions, Enumerations, and Typedef: Structures, Array of structures, passing structures to functions, Structure pointers, Arrays and structures within structures, Unions, Bit-fields, Enumerations, typedef.

File I/O: Streams and files, File system basics, fread() and fwrite(), fseek() and random access I/O, fprintf() and fscanf(), Standard streams.

Pre-processor and Comments: Pre-processor, #define, #error, #include, Conditional compilation directives, #undef, Single line and multiple line comments.

Recommended Books:

1. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
2. K.N. King, C Programming: A Modern Approach, W W Norton & Company, Inc

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MCA- C102 Software Engineering				
	L	T	P	C
	4	0	0	4

Course objective:

1. To understand the Software Engineering Practices and Process Models.

Course outcomes:

1. Assessment in each module gives the overall Software engineering practice.
2. Ability to enhance the software project management skills.
3. Ability to design and develop a software product in accordance with Software Engineering principles.

Software Process: Software Process, Characteristics, software development process models - Waterfall, Iterative, Prototype, Incremental, Spiral, win-win Spiral, Comparison. Project Management Process.

Software Requirement Analysis and specification: Software Requirements, need for SRS, Problem analysis, Requirements specification, IEEE format of SRS, Requirements Engineering, Requirements Validation, Object-oriented Analysis Case Studies - Course Scheduling, Personal Investment Management System

Software Architecture: Role of Software Architecture, Architecture views, Component and Connector view. Architectural styles of C&C view. Evaluating Architectures.

Software Design: Function Oriented Design: Principles, Module-level Concepts. Design notations and specifications, Structured design methodology, Verification, Metrics; Object-oriented design: OO Concepts, Design Concepts, Unified Modeling Language (UML); User Interface Design: Golden rules, User Interface Design, Interface Design Activities, Implementation tools

Testing Techniques & Strategies: Fundamentals, Test case design, white box, black box, basis path, control structure testing, Strategic approach to software testing, Unit testing, Integration testing, Validation testing & System Testing.

Software Maintenance: Definition, Maintenance activities, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering.

Effort & Schedule Estimation: Software Project Estimation, Decomposition techniques, Empirical Estimation Models (COCOMO, Function Point Analysis, Delphi Approach), The Make/Buy decision. Automated Estimation tools.

Recommended Books:

1. Agarwal, KK, et. al., Software Engineering, New Age International Publication
2. Jalote Pankaj, An Integrated Approach to Software Engineering, Narosa Publishing House, New Delhi
3. Pressmann, RS, Software Engineering – A Practitioner's Approach, McGraw- Hill International Editions.
4. Sommerville, Ian, Software Engineering, Pearson Education Asia,
5. Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering: Using UML, Patterns and Java, Pearson Education Asia

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MCA- C103 Computer System Architecture				
	L	T	P	C
	3	1	0	4

Course objective:

1. To understand the basic hardware and software issues of computer organization.
2. To provide an overview on the design principles of digital computing systems.
3. To understand the representation of data at machine level.

Course outcomes:

1. Ability to analyze the abstraction of various components of a computer.
2. Ability to apply performance metrics to find the performance of systems.

Digital Electronics: Boolean algebra and logic Gates, Simplification of Boolean Functions, Adders, subtractors, Binary parallel adder, Decimal adder, Magnitude comparator, Decoders, Multiplexers. Flip- flops (RS, D, JK, Master- slave & T flip-flops), Flip- flop Excitation table, analysis, Design of counters, Design with state equations, Registers, Shift register, Ripple Counter, Synchronous Counters, Timing sequences.

Central Processing Unit: Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt, Bus Interconnection design of basic computer, register organization; Stack organization; Instruction Format and Addressing Modes.

Control Unit: Control memory, Address Sequencing, Micro program, Design of Control Unit.

Arithmetic Algorithms: Integer multiplication; Integer division, Floating point representations and Arithmetic algorithms.

I/O Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Data Transfer, Priority Interrupt, Direct Memory Access, Input Output Processor.

Memory Organization: Memory Hierarchy, RAM, ROM, Associative Memory, Cache Memory Organization and Virtual Memory Organization.

Recommended Books:

1. Hayes J.P, *Computer Architecture and Organization*, McGraw Hill
2. Hamacher Cart, Vranesic Zvono, Zaky Safwat, *Computer Organization*, McGraw Hill
3. Mano M. Morris, *Computer System Architecture*, Third Edition, PHI

Vivek

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MCA- C104 Mathematical Foundations for Computer Science				
	L	T	P	C
	3	1	0	4

Course objective:

1. Use mathematically correct terminology and notation.
2. Apply logical reasoning to solve a variety of problems.

Course outcomes:

1. For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives
2. For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference
3. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
4. Organize, manage and present data.
5. Analyze statistical data using measures of central tendency, dispersion and location
6. Develop the given problem as graph networks and solve with techniques of graph theory

Sets, Relations and Functions: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem

Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic. Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency

Probability and Statistics: Introduction to data - Types of variables; data collection principles; types of studies, examining numerical data - Graphical methods: histograms and other graphs, Numerical methods: the average, the standard deviation, etc., Examining categorical data- Tabular methods: contingency tables, Graphical methods: bar plots and other graphs, Elementary probability rules, Conditional probability, Random variables, Normal Distribution, Binomial distribution

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances

Recommended Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill
2. Thomas Dietz, Linda Kalof, Introduction to Social Statistics, Wiley
3. P. Trembley and R. P. Manohar, Discrete Mathematical Structures with applications to Computer Science, McGraw Hill

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MCA- C105 Database Management System				
	L	T	P	C
	4	0	0	4

Course objective:

1. To learn data models, conceptualize and depict a database system using ER diagram.
2. To understand the internal storage structures in a physical DB design.
3. To know the fundamental concepts of transaction processing techniques.

Course outcomes:

1. For a given specification of the requirement design the databases using E-R method and normalization.
2. For a given specification construct the SQL queries
3. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
4. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling

Introduction: Purpose of Database System, Views of data, data models, database management system, three-schema architecture of DBMS, components of DBMS, ER Model, notations, examples.

Relational Model: Relational Data Model, Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL: Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

Database Design: Dependencies and Normal forms, dependency theory, functional dependencies, Armstrong's axioms for FD's, closure of a set of FDs', minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization.

Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Implementation Techniques: Data Storage and Indexes, File organizations, primary, secondary index structures, various index structures, hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Recommended Books:

1. Silberschatz, H F Korth and S. Sudarshan, Database System Concepts, McGraw Hill
2. Elmasari and Navathe, Fundamentals of Database Systems, Addison Wesley Publishing Company

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MCA- C106 Operating Systems				
	L	T	P	C
	4	0	0	4

Course objective:

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms

Course Outcomes:

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
4. Design and implement file management system.
5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers

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, Concept of Virtual Machine

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging,

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Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Case study on UNIX and WINDOWS Operating System.

Recommended Books:

1. Silberschatz, A. and Galvin, P. B., Operating System Concepts, Addison Wesley,
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India.

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MCA- C151 DBMS Lab				
	L	T	P	C
	0	0	4	2

Course objective:

1. To give a good formal foundation on the relational model of data.
2. To present SQL and procedural interfaces to SQL comprehensively

Course outcomes:

1. Ability to design and implement a database schema for a given problem-domain.
2. Ability to Normalize a database.
3. Populate and query a database using SQL DML/DDL commands.

List of Experiments:

1. SQL and installation of SQL server/oracle.
2. Data Definition Language (DDL) commands in RDBMS
3. Data Manipulation Language (DML) and Data Control Language (DCL)
4. High level language extensions with cursors
5. Data types and create a database and write the program to carry out the following operation.
    - Create tables department and employee with required constraints.
6. Working with null values, matching the pattern from the table.
7. Aggregate functions: grouping the result of a query.
8. Set operators, Nested Queries, Joins and Sequences.
9. Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
10. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
11. Triggers and Cursor Management in PL/SQL.
12. Procedures and Functions

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MCA- C152 C on Linux Lab				
	L	T	P	C
	0	0	4	2
Lab objective: 1. Ability to enhance their analyzing skills. 2. Problem solving skills and use the same for writing programs in C.				
Lab outcomes: 1. Ability to write C programs using logic. 2. Ability to solve small real-world problems using C programs.				
List of Experiments: 1. Sequence construct. 2. Selection construct. 3. Iterative construct. 4. Nested for loops. 5. Functions 6. Recursive functions. 7. One dimensional and two-dimensional arrays. 8. Pointers and functions. 9. Pointers and Arrays. 10. Structure and Union. 11. File Processing.				

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MCA- C201 Data Structures				
	L	T	P	C
	4	0	0	4

Course objective:

1. To impart the basic concepts of data structures.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures.

Course outcome:

1. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
2. For a given problem of Stacks, Queues and linked list student will able to implement it
3. Student will able to write an algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort
4. Student will be able to implement BST, Graph search and traversal algorithms

Arrays, Stacks and Queues: Representation of Array (Single & Multi-Dimensional Arrays), Address Calculation using Column & Row Major Ordering, Representation of Stacks & Queues Using Arrays and their Operations, Circular Queues, Conversion from Infix to Postfix and Evaluation of Postfix expressions using Stack.

Linked List: Singly linked list (operations on list), Linked stacks and queue, Polynomial representation and manipulation using linked list; Reading and Writing polynomials, Polynomial addition. Circular Linked list and doubly linked list.

Trees: Definition, BST traversal methods (Preorder, Postorder and Inorder), Recursive and non- recursive algorithms for traversal methods, Insertion into and deletion from a BST and their implementation. B- trees: Definition, Insertion and Deletion operations.

Searching and Sorting: Sequential & binary searches; Hashing schemes: hashing, Hash functions, Collision functions, Open addressing (Linear probing and modification), Chaining; Sorting methods: Insertion, selection, Bubble, Quick, Merge and Heap sorts.

Threaded binary tree: Introduction, Threads, in-order, preorder and post-order traversal, Insertion in Threaded tree.

Graph: Introduction. Representation: Adjacency Matrix and Adjacency List. *Graph Traversals:* Depth First Search, Breadth First Search. Applications of Graphs.

Recommended Books:

1. Kruse, Leung and Tondo, Data Structures and Program Design in C, PHI.
2. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Publ.

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MCA- C202 Computer Networks				
	L	T	P	C
	3	1	0	4

Course objective:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).

Course outcomes:

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
3. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
4. Configure DNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Data communication Components: Representation of data and its flow Networks, Various Connection Topologies, Protocols and Standards, OSI model, Transmission Media

LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN

Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

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

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Transport Layer: Process-to-Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Recommended Books:

1. Behrouz A. Forouzan, Data Communication and Networking, McGraw- Hill
2. William Stallings, Data and Computer Communication, Pearson

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MCA- C203 Theory of Computer Science				
	L	T	P	C
	3	1	0	4

Course objective:

1. Develop a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Prove that a given language is regular and apply the closure properties of languages.
4. Design context free grammars to generate strings from a context free language and convert them into normal forms.
5. Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
6. Identify the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability and undecidability

Course outcomes:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. For a given language determine whether the given language is regular or not.
4. Design context free grammars to generate strings of context free language.
5. Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
6. Write the hierarchy of formal languages, grammars and machines.
7. Distinguish between computability and non-computability and Decidability and undecidability.

Introduction to Languages; Recursive Definitions; Regular Expressions; Finite Automata; Transition Graphs; Kleene's Theorem;

Non- Deterministic Finite Automata, Finite Automata with Output - Moore and Mealy machines, Equivalence of Moore and Mealy machines; Regular Languages; Non-regular Languages; Decidability.

Context-Free Grammars. Trees; Regular Grammars; Chomsky's Normal Form; Pushdown Automata; Context- Free Languages; Non- Context- Free Languages; Parsing; Decidability for CFG - Emptiness, Finiteness and Membership questions about CFG.

Turing Machines (TM); Post Machines (PM), simulating a PM on TM.

Recursively Enumerable Languages; Encoding of Turing Machines; Phrase Structure Grammar; Context Sensitive Grammar; Defining the Computer and Computable Functions; Church's Thesis; Halting Problem for Turing Machines.

Recommended Books:

1. Cohen, Daniel I.A., Introduction to Computer Theory, John Wiley & Sons
2. K. L. P. Mishra and N. Chandrasekaran, Theory of Computer Science: Automata Languages and Computation, PHI

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MCA- C204 Object Oriented Technology				
	L	T	P	C
	4	0	0	4

Course objective:
The course will introduce standard tools and techniques for software development, using object-oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.

Course outcomes:
1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.

Introduction: Fundamental concepts, Objects and legacy systems, Procedural vs OO programming, Object data, object behavior, creating objects, attributes, methods, messages, encapsulation and data hiding, super classes and sub classes, abstraction, Is-a relationship, polymorphism, abstraction, Has-a relationship

Objects: The interface, the implementation, determining the users, object behavior, environmental constraints, identifying the public interfaces, identifying the implementation

Advanced concepts: Constructors, error handling, importance of scope, operator overloading, multiple inheritance, object operations

Anatomy of a class: Name, comments, attributes, constructors, assurors, public interface methods, private implementation methods

Class design guidelines: modeling real world systems, identifying the public interfaces, designing robust constructors, designing error handling into a class, designing reuse in mind, designing extensibility in mind, designing maintainability in mind, using object persistence

Designing with objects: Performing the proper analysis, developing a statement of work, gathering the requirements, developing the prototype, identifying the classes, determining the responsibility of a class, creating a class model, prototyping the user interface, object wrappers

Inheritance and composition: Reusing objects, generalization and specialization, design decisions, representing composition with UML, object responsibility, abstract classes, virtual methods and protocols

Frameworks and reuse: Framework, contract, abstract classes, interfaces, making a contract, an E-business example

Object-oriented design: Composition relationships, building in phases, types of compositions, avoiding dependencies, cardinality

Creating object models: What is UML? Structure of a class diagram, attributes and methods, access designations, inheritance, interfaces, composition, cardinality

Design patterns: Why design patterns, model-view-controller, types of design patterns, anti-patterns

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Recommended Books:

1. Weisfeld M., The Object-Oriented Thought Process, Addison-Wesley Professional
2. Shalloway A., Trott J., Design Patterns Explained: A New Perspective on Object-oriented Design, Addison-Wesley
3. Fowler M., UML Distilled, Addison-Wesley

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MCA- O205 Online Course				
	L	T	P	C
	4	0	0	4
This course has to be completed by the students by choosing courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. **The awarded certificate must be submitted for the award of credits in this course.** This is **an open course** which student can select from the offered online courses and **can be of any discipline** of the interest of the student but should not be the courses offered in this Programme of study.				

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MCA- E206 Computer Graphics				
	L	T	P	C
	4	0	0	4

Course objective:

1. To understand the basics of various inputs and output computer graphics hardware devices.
2. To know 2D raster graphics techniques, 3D modelling, geometric transformations, 3D viewing and rendering.

Course outcomes:

1. Ability to understand the various computer graphics hardware and display technologies.
2. Ability to implement and apply various 2D and 3D objects transformation techniques

Introduction to Computer Graphics: Video display devices, Raster- scan systems, Random- scan systems, Graphics monitors and workstations, Input devices, hardcopy devices, Computer graphics software. Point plotting techniques: Points and lines, line-drawing algorithm, Circle generating algorithms, Ellipse- generating algorithms.

Two-Dimensional Transformations: Transformations of Points, Transformations of Straight Lines, Mid-Point Transformations, Transformations of Parallel Lines, Transformations of Intersecting Lines, Rotation, Reflection, Scaling, Projection, Combined Transformation, Transformation of the unit square.

Three-Dimensional Transformation: Introduction to Three- Dimensional Transformation, 3-D Scaling, Shearing, Rotation, Reflection, Projection and Translation, Multiple Transformation, Rotation about an Axis parallel to a Coordinate Axis, rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane.

Two-Dimensional Viewing: viewing pipeline, viewing coordinate reference frame, window- to- viewport coordinate transformation, Clipping operations, point clipping, Cohen- Sutherland line clipping, Sutherland- Hodgeman polygon clipping, Curve clipping, Text clipping, Exterior clipping.

Visible Surface Detection Methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP tree methods, area sub-division and octree methods.

Computer Animation: Design of animation sequences, General computer- animation functions, Raster animations, Computer- animation languages, Key- frame systems morphing simulating accelerations, Motion specifications.

Recommended Books:

1. Hearn D., Baker P.M., Computer Graphics, Prentice-Hall of India
2. Rogers and Adams, Mathematical Elements of Computer Graphics, McGraw Hill Book Co
3. Newman, W., Sproul, R.F., "Principles of Interactive Computer Graphics", McGraw-Hill

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MCA- E207 Digital Image Processing				
	L	T	P	C
	4	0	0	4

Course objective:

1. To understand the fundamentals of Digital imaging and Image Processing techniques.
2. To be familiar with image compression and segmentation.

Course outcomes:

1. Ability to design and apply image enhancement and restoration techniques.
2. Ability to apply image compression and segmentation techniques.
3. Ability to design and develop image processing techniques for assisting digital forensics.

Introduction: Fundamentals: Digital Image Representation, Reading, Displaying and Writing images, Data Classes, Image Types, Converting between data classes and image types, array indexing, Some important standard arrays.

Image Transformations and Spatial Filtering: Intensity Transformation functions, Histogram processing and function plotting, Spatial filtering, Image processing toolbox, Standard spatial filters

Frequency Domain Processing: The 2D discrete Fourier transform, Filtering in the frequency domain, obtaining frequency domain filters form spatial filters, generating filters directly in the frequency domain, Sharpening frequency domain filters

Image Restoration: A model of the image Degradation/ Restoration process, Noise models, Restoration in the presence of noise only, Periodic noise reduction by frequency domain filtering, Modeling the degradation function, Direct Inverse Filtering, Wiener Filtering

Color Image Processing and Image Compression: Color Image representation, converting to other color spaces, the basic of color image processing, Color transformations, Spatial Filtering of color images, working directly in RGB Vector Space. Image Compression: Coding redundancy, Interpixel redundancy, Psychovisual redundancy, JPEG Compression.

Recommended Books:

1. Gonzalez Rafael C., Woods Richard E. and Eddins Steven L., *Digital Image Processing using MATLAB*, Gatesmark Publishing
2. A.K. Jain, Fundamentals of Digital Image Processing, PHI

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MCA- E208 Graph Theory				
	L	T	P	C
	4	0	0	4

Course objective:

1. To explain basic concepts in combinatorial graph theory.
2. To define how graphs, serve as models for many standard problems

Course outcomes:

1. Solve problems using basic graph theory
2. Identify induced subgraphs, matchings, covers in graphs
3. Determine whether graphs are Hamiltonian and/or Eulerian
4. Solve problems involving vertex and edge connectivity, planarity and crossing numbers
5. Solve problems involving vertex and edge coloring
6. Model real world problems using graph theory

Introduction: Applications of Graphs; Finite and Infinite Graphs; Incidence and Degree; Isolated and Pendant Vertex; Isomorphism; Sub Graph, Walks, Paths and Circuits; Connected and Disconnected Graphs; Components of A Graph; Euler Graphs; Hamiltonian Paths and Circuits; The Traveling Salesman Problem.

Trees, Circuits and Cut-sets: Properties of Trees; Pendant Vertices in A Tree; Center of A Tree; Rooted and Binary Trees; Spanning Tree, Spanning Trees in A Weighted Graph, Algorithm for Shortest Spanning Tree, Fundamental Circuits, Cut-sets and Cut Vertices; Fundamental Cut-sets, Connectivity and Separability.

Planar Graphs: Combinatorial Vs Geometric Graphs; Planar Graph; Kuratowski's Graphs; Detection of Planarity; Geometric Dual; Thickness and Crossings.

Matrix representation and coloring: Path Matrix, Cut- Set Matrix, Circuit Matrix, Incidence Matrix, Adjacency Matrix and Their Properties. Chromatic Number, Chromatic Polynomial, Chromatic Partitioning, Matchings, Covering and Four-Color Problem;

Directed Graphs: Digraphs and Binary Relations; Directed Path and Connectedness; Adjacency Matrix of Digraph

Directed Tree: Arborescence; Paired Comparison and Tournaments; Counting Labeled and Unlabeled Trees.

Algorithms: Shortest path, minimal spanning tree, Connectedness and components, Fundamental circuits, Cut- vertices and separability, Isomorphism.

Recommended Books:

1. N. Deo, Graph Theory with Applications to Engineering and Computer Science, PHI
2. Richard J. Trudeau, Introduction to Graph Theory, Dover Publications Inc

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MCA- C251 Data Structures Lab				
L	T	P	C	
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Lab objective: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Lab outcomes:

1. Compare different implementations of data structures and to recognize the advantages and disadvantages of them.
2. Understand and apply fundamental algorithmic problems including tree traversals and graph traversals.

List of Experiments:

1. Array Operations.
2. Matrix Operations.
3. Searching.
4. Sorting
5. Queues
6. Stacks and Linked Lists
7. Singly, doubly and circular linked list and insertion, deletion, traversal operations.
8. Infix to postfix expression using stack data structure.
9. Tree traversal algorithms.
10. Create a binary search tree of given integers and perform different traversal operations.
11. Insertion into and Deletion from a B-tree.
12. Knuth-Morris- Pratt pattern matching algorithm.
13. DFS, BFS graph traversal algorithms.
14. Reverse the elements in the stack using recursion

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MCA- C252 OOP Lab				
	L	T	P	C
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Lab objective:

1. To understand the object-oriented principles.
2. To construct the robust and maintainable programs.
3. To design, write, compile, test and execute programs using high level language.

Lab outcomes:

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.

List of Experiments:

1. Basic programming concepts.
2. Arrays.
3. Matrices and multi-dimensional arrays.
4. Pointers/References
5. Methods/Functions and using inline functions.
6. Methods/Function overloading.
7. Classes and objects
8. Operator overloading.
9. String operations
10. Inheritance.
11. File Handling
12. Exception Handling.
13. Generic Programming

The concepts should be practiced using C++/Java

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MCA- C301 Machine Learning				
	L	T	P	C
	4	0	0	4

Course objective: This course provides an advanced level of understanding to machine learning and statistical pattern recognition. It offers some of the most cost-effective approaches to automated knowledge acquisition in emerging data-rich disciplines and focuses on the theoretical understanding of these methods, as well as their computational implications.

Course Outcomes:

1. Demonstrate in-depth knowledge of methods and theories in the field of machine learning. To introduce the basic principles, techniques, and applications of Machine Learning, Classification Tasks, Decision tree learning
2. Understand and use Bayesian perspective on machine learning, Artificial neural networks, back propagation algorithm
3. Assess learning algorithms modelled after biological evolution, including Genetic Algorithm
4. Demonstrate knowledge of the disciplinary foundation and of proven experience in the design and analysis of learning algorithms and systems. To demonstrate the ability to critically evaluate and compare different learning models and learning algorithms and be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.

Introduction: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning, Reinforcement learning

Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Bayesian Learning: Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier, Bayesian belief networks, The EM algorithm.

Artificial Neural Network: Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, dynamically modifying network structure.

Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms.

Data Mining Techniques for Analysis: Classification: Decision tree induction, Bayes classification, Rule-based classification, Support Vector Machines, Classification Using Frequent Patterns, k-Nearest-Neighbor, Fuzzy-set approach Classifier, Clustering: K-Means, k-Medoids, Agglomerative versus Divisive Hierarchical Clustering Distance Measures in Algorithmic Methods, Mean-shift Clustering

Recommended Books:

1. Mitchell T.M., Machine Learning, McGraw Hill
2. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag
3. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press

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MCA- C302 Cyber Security				
	L	T	P	C
	4	0	0	4

Course objective:
The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains. The course aims at providing students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques.

Course outcomes:

1. Understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.
2. Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios
3. Identify common trade-offs and compromises that are made in the design and development process of Information Systems
4. Demonstrate the use of standards and cyber laws to enhance information security in the
5. development process and infrastructure protection

Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning).

Cryptography and Cryptanalysis: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography: Algorithm types and modes, DES, RSA, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security, Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Infrastructure and Network Security: Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems

Cyber Security Vulnerabilities & Safe Guards: Internet Security, Cloud Computing &Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment.

Malware: Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis

Security in Evolving Technology: Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Introduction, Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP,

REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Cyber Laws and Forensics: Introduction, Cyber Security Regulations, Roles of international Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013. Introduction to Cyber Forensics, Need of Cyber Forensics, Cyber Evidence, Documentation and Management of Crime Sense, Image Capturing and its importance, Partial Volume Image, Web Attack Investigations, Denial of Service Investigations, Internet Crime Investigations, Internet Forensics, Steps for Investigating Internet Crime, Email Crime Investigations.

Recommended Books:

1. William Stallings, Cryptography and Network Security, Pearson Education/PHI
2. Sarika Gupta and Gaurav Gupta, Information Security and Cyber Laws, Khanna Publishing House, Delhi
3. V.K. Pachghare, Cryptography and Information Security, PHI Learning Pvt. Ltd

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MCA- C303 Cloud Computing				
	L	T	P	C
	4	0	0	4

Course objective:

1. To understand the basics of Cloud Computing.
2. To understand the movement from a traditional network infrastructure to a Cloud solution.

Course outcomes:

1. To assess existing hosting Cloud platforms and computing paradigms currently being used in industry and academia
2. To comprehend the need of data centre, its virtualization techniques and types of clouds.
3. To demonstrate the implementation of cloud by using Amazon Web Services, Azure, Google App Engine. And its virtualization.
4. To demonstrate the use of Hadoop framework, data storage and MapReduce using real world applications

Introduction and Evolution of Computing Paradigms: Overview of Existing Hosting Platforms, Cluster Computing, Grid Computing, Utility Computing, Autonomic Computing, Fog Computing, Introduction to Cloud Computing, Cloud Computing history and evolution, practical applications of cloud computing for various industries, HealthCare and education, and benefits of cloud computing.

Cloud Issues and Challenges: Cloud computing issues and challenges like Security, Elasticity, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Cost Management, Big Data, Energy Efficiency, Load Balancing.

Cloud Computing Architecture: Cloud Architecture model, Types of Clouds: Public Private & Hybrid Clouds, Cloud based services: Iaas, PaaS and SaaS

Classification of Cloud Implementations: Amazon Web Services, The Elastic Compute Cloud (EC2), The Simple Storage Service (S3), DyanmoDB, The Simple Queuing Services (SQS), Google AppEngine – PaaS, Windows Azure, Aneka, A Comparison of Cloud Computing Platforms

Virtualization: Virtualization, Advantages and disadvantages of Virtualization, Types of Virtualization: Resource Virtualization-Server, Storage and Network virtualization, Migration of processes, Classic Data Center, Virtualized Data Center (Compute, Storage, Networking and Application), Business Continuity in VDC.

Cloud based Data Storage: Introduction to Map Reduce, Design of data base applications based on Map Reduce in Apache Hadoop, Task Partitioning, Data partitioning, Hadoop Schedulers, Data Synchronization, Distributed File system, Data Replication

Recommended Books:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Mastering Cloud Computing Tata McGraw Hill
2. Barrie Sosinsky, Cloud Computing Bible. Wiley India Pvt. Ltd
3. Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski, Cloud Computing: Principles and paradigms , Wiley India Pvt. Ltd

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MCA- C304 Design and Analysis of Algorithms				
	L	T	P	C
	4	0	0	4

Course objective:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

Course outcomes:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

Recommended Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, MIT Press/McGraw-Hill
2. E. Horowitz et al, Fundamentals of Algorithms

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MCA- O305 Online Course				
	L	T	P	C
	4	0	0	4
This course has to be completed by the students by choosing courses from NPTEL/SWAYAM/MOOCs/etc. They should undergo the online course completely, submit assignments, projects, etc. and appear for the final exam conducted by the online instructor. **The awarded certificate must be submitted for the award of credits in this course.**				
This is **an online course** which student can select from the offered online courses and **must be of Computer discipline** but should not be the **core** courses offered in this Programme of study.				

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MCA- E306 Big Data Analytics				
	L	T	P	C
	4	0	0	4

Course objective:

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide hands on Hadoop Eco System
6. Apply analytics on Structured, Unstructured Data.

Course outcomes:

1. Identify Big Data and its Business Implications.
2. List the components of Hadoop and Hadoop Eco-System
3. Access and Process Data on Distributed File System
4. Manage Job Execution in Hadoop Environment
5. Develop Big Data Solutions using Hadoop Eco System

Introduction: Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System

HDFS (Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

HBase: HBasics, Concepts, Clients, Example, HBase Versus RDBMS.

Spark: RDD, Shared variables, Anatomy of a Spark Job Run, Executers and Cluster managers

Recommended Books:

1. Tom White, Hadoop: A Definitive Guide, O'Reilly Media
2. Seema Acharya, Big Data and Analytics, Wiley

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MCA- E307 Internet of Things				
	L	T	P	C
	4	0	0	4

Course objective:

1. To impart necessary and practical knowledge of components of Internet of Things

Course outcomes:

1. Understand internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices

Introduction: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

Elements of IOT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

IOT Case studies: Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Recommended Books:

1. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press
2. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, A Hands-on Approach, University Press
3. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press

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MCA- E308 Android Application Development				
	L	T	P	C
	4	0	0	4

Course objective:

1. To facilitate students to understand android SDK
2. To help students to gain a basic understanding of Android application development
3. To inculcate working knowledge of Android Studio development tool

Course outcomes:

1. Ability to comprehend Android platform and its usefulness in application development.
2. Ability to acquire skill set to execute applications in Android based devices.
3. Ability to design and develop deployable Android applications

Introduction to Android: The Android Platform, Android SDK, Android Studio installation, Android Installation, building 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.

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

Using Common Android APIs: Using Android Data and Storage APIs, managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Recommended Books:

1. Meier Reto and Lake Ian, *"Professional Android"*, Wrox
2. John Horton, Android Programming for Beginners, Packt Publishing

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MCA- E309 Soft Computing				
	L	T	P	C
	4	0	0	4

Course objective:

1. Develop the skills to gain a basic understanding of neural network theory, fuzzy logic theory and Genetic Algorithm
2. Introduce students to artificial neural networks, fuzzy theory and Genetic algorithm from an engineering perspective

Course outcomes:

1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory
2. Apply artificial neural networks and fuzzy logic theory for various problems
3. Determine the use of Genetic algorithm to obtain optimized solutions to problems

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Neural Networks: Introduction, what is Neural Network, Learning rules and various activation functions, Supervised Learning Networks, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications. Unsupervised Learning Networks.

Fuzzy Systems: Fuzzy Set theory, Fuzzy vs. Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

Introduction to Hybrid Systems.

Recommended Books:

1. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Wiley India
2. Samir Roy, Udit Chakraborty, Soft Computing, Pearson India

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MCA- E310 Remote Sensing and GIS				
	L	T	P	C
	4	0	0	4

Course objective:

1. To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of Natural Resources, Man-made Objects, Agriculture and management using Remote Sensing and GIS
2. To enhance programming and tool handling skills in preparing, storing, modeling, managing digital data for planning and development
3. To provide maximum opportunities to get the job in RS and GIS based software industries, institutions, consultancies etc.
4. To acquire skills in advance techniques such as multispectral, hyper spectral, thermal and LiDAR imaging, scanning, processing for mapping, modeling and monitoring

Course outcomes:

1. Fully equipped with concepts, methodologies and applications of Remote Sensing and GIS Technologies
2. Acquire skills in handling software, programming, instruments, tools, techniques and modeling while using Remote Sensing and GIS Technologies.

Statistical Mathematics: Basics of Statistics for Image Processing, Regression, Least Square Analysis & Probability Distributions

Remote Sensing (Remote Sensing): RS Data Acquisition Mechanism, Satellites, GPS, Introduction to Satellite Image Processing, Image Formats and Properties, Image Preprocessing, Image Enhancement, Image Classification, Image Fusion, LU/LC, Change Detection, Multispectral and Hyperspectral Remote Sensing, Basics of Satellite Photogrammetry, Microwave and LiDAR Remote Sensing.

GIS (Geographical Information System): Introduction to Geographic Information Systems (GIS), Spatial Data, Vector Data, Raster Data, GIS Software and Application, Digital Image Processing in GIS, Geospatial Database Generation, Spatial Data Analysis with GIS, Web GIS, Technology and Trends in GIS.

Applications (EARDAS/ENVI/QGIS): Satellite Image Representation (Pixel and Object), Image Subset, Image Preprocessing, Layer Staking, ROI, Development of Spectral Signatures, Image Compression, Image Classification (Supervised and Unsupervised) and Image Post Classification. GPS Survey, Creation of Vector Layers in QGIS, Geo-referencing and Projection, Spatial Data Analysis, Vector Data Analysis, Raster Data Analysis, Map Composition, Network Routing, Multi-Criteria Analysis, Demo on Unmanned Aerial Vehicle

Recommended Books:

1. Basudeb Bhatta, Remote Sensing and GIS, Oxford Press
2. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, Remote Sensing and Image Interpretation, John Wiley & Sons
3. Gary Sherman, The PyQGIS Programmer's Guide: Extending QGIS 3 with Python 3, Locate Press

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MCA- E311 Compiler Design				
	L	T	P	C
	4	0	0	4

Course objective:

1. To understand and list the different stages in the process of compilation.
2. Identify different methods of lexical analysis
3. Design top-down and bottom-up parsers
4. Identify synthesized and inherited attributes

Course outcomes:

1. For a given grammar specification develop the lexical analyzer
2. For a given parser specification design top-down and bottom-up parsers
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

Introduction to Compilers: Compilers and Translators; Need of Translators; Structure of Compiler; Lexical Analysis; Syntax Analysis; Intermediate Code Generation; Optimization; Code Generation; Book Keeping; Error Handling; Compiler Writing Tools.

Finite Automata (FA) and Lexical Analyzer (LA): Role of LA, design of LA, Regular Expression, FA, Regular Expression to FA, Minimizing the number of states in a DFA.

Syntactic Specification of Programming Languages: Context Free grammars, Derivation and Parse Trees, Capabilities of context free grammars.

Basic Parsing Techniques: Parsers, Shift-reduce Parsing, Operator-Precedence Parsing, Top Down Parsing, Predictive Parser.

Automatic Construction of Efficient Parsers: LR Parsers, Canonical Collection of LR (0) items, Constructing SLR Parsing Tables, Constructing Canonical LR Parsing Tables, Constructing LALR Parsing Tables.

Syntax-Directed Translation: Syntax-Directed Translation Schemes, Implementation of Syntax Directed Translators, Intermediate Code, Postfix Notation, Parse Trees & Syntax Trees, Three- address code, quadruples and triples.

Symbol Tables (ST): Contents of ST, Data Structures for STs.

Error Detection and Recovery: Errors, Lexical Phase Errors, Syntactic Phase Errors, Semantic Errors.

Introduction to Code Optimization: Sources of Optimization, Loop optimization.

Code Generation: Object Programs, Problems in Code Generation.

Recommended Books:

1. A.V.Aho, R.Sethi & J.D. Ullman, Principles of Compiler Design, Narosa Publishing House
2. A.V. Aho, R. Sethi & J.D. Ullman, Compilers - Principles, Techniques & Tools, Addison Wesley.

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MCA- E312 Data Science				
	L	T	P	C
	4	0	0	4

Course objective:

1. To introduce students to the basic concepts of Data Science.
2. To become familiar with data preprocessing methods.
3. To learn and demonstrate the application of statistical data analysis techniques in business decision making.
4. To gain knowledge on strategies for data transformation.
5. To learn to implement Data Science related applications in Python.

Course outcomes:

1. Learn methods in integrating and interpreting the data sets and improving effectiveness, efficiency and quality for data analysis.
2. Gain practical, hands-on experience with principles of Data Science to the analysis of business problems

Introduction to Data Science: What is data science? Basic terminology, Why data science? The data science Venn diagram. Domain knowledge, Data Science case studies

Data Representation: Data Objects and Attribute Types: Nominal, Binary, Ordinal, Numeric, Discrete and Continuous, Types of data: Record, Temporal, Spatial Temporal, Graph, Unstructured and Semi structured data, Basic Statistical Descriptions of Data.

Introduction to Data Analysis: Probability and Random Variables, Correlation, Regression.

Exploratory Data Analysis: What is Exploratory Data Analysis? EDA Techniques, EDA Classification, Univariate Non-graphical EDA, Univariate Graphical EDA, Bivariate Non-graphical EDA, Bivariate Graphical EDA, Philosophy of EDA, The Data Science Process

Data Preprocessing: Meaning, Data Quality, Major Tasks in Data Preprocessing, *Data Cleaning* - Missing Values, Noisy Data, Data Cleaning as a Process, *Data Integration* - Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution, *Data Reduction Strategies* - Overview, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation, *Data Transformation Strategies* : Overview, Normalization, *Data Discretization* and Binning, Histogram Analysis, Cluster, Decision Tree, and Correlation Analyses, Concept Hierarchy Generation for Nominal Data

Introduction to Probability: Common terminology of Probability, Events, Union, Intersection, Types of Events, Rules of Probability, Types of Probability: Marginal, Joint, Conditional, Bayesian Inference: Bayes Theorem, Random Variable, General Product Rule

Introduction to Statistics: Standardization (Z-score), Data Distribution (Poisson Distribution and Normal Distribution), Sampling Theorem, Hypothesis Testing, ANOVA test, Chi-square test, p-values

Machine Learning: What is Machine Learning? AI vs ML vs DL, Significance of Machine Learning, Applications of Machine Learning in data science, Supervised, Unsupervised and Reinforcement Learning, Classification and Regression, Cross Validation.

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Data Visualization: Traditional Visualization, Multivariate Data Visualization, Principles of Perception, Color, Design, and Evaluation, Text Data Visualization, Network Data Visualization, Temporal Data Visualization and visualization Case Studies.
Recommended Books: 1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline, O'Reilly 2. Sinan Ozdemir, Principles of Data Science, Packt Publishing 3. Han, J., Kamber, M. and Pei, J., Data Mining Concepts and Techniques, Morgan Kaufmann 4. Hastie, T., Tibshirani, R. and Friedman, J., The Elements of Statistical Learning, Springer 5. Simon, P., The Visual Organization: Data Visualization, Big Data, and the Quest for Better Decisions, John Wiley & Sons

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MCA- C351 Python Programming Lab				
	L	T	P	C
	0	0	6	3

Lab objective:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.
5. To define the structure and components of a Python program.
6. To learn how to write loops and decision statements in Python.

Lab outcomes:

1. Able to apply the principles of python programming.
2. Write clear and effective python code.
3. Create applications using python programming.
4. Implementing database using SQLite.
5. Access database using python programming.
6. Develop web applications using python programming.
7. Develop and use Web Services using python.

Introduction to Python: History, Features, setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator

Conditional Statements & Looping: If, If- else, Nested if-else, For, While, Nested loops, Break, Continue, Pass

String Manipulation: Accessing Strings, Basic Operations, String slices, Function and Methods, Formatting strings

Lists, Tuple and Dictionaries: Lists – Introduction, accessing list, Operations, working with lists, Function and Methods, Tuple – Introduction, accessing tuples, Operations, Working, Functions and Methods, Dictionaries - Introduction, accessing values in dictionaries, working with dictionaries, Properties, Functions

Functions: Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Function documentation, Keyword and optional parameters, *args and **kwargs, passing collection to a function, variable number of arguments, scope, functions – "First Class Citizens", Passing functions to function, mapping functions in a dictionary, Global and local variables

Modules: Importing module, Math module, Random module, Packages, Composition, dir function

Input-Output: Printing on screen, reading data from keyboard, Opening and closing file Reading and writing files, Working with Directories, Metadata

Object and Classes: Classes in Python, Principles of Object Orientation, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes

Error Handling: Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions

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Regular expressions: Match function, Search function, Matching VS Searching, Modifiers Patterns **CGI:** Introduction, Architecture, CGI environment variable, GET and POST methods, Cookies, File upload **Database:** Introduction, Connections, Executing queries, Transactions, Handling error
Recommended Books: 1. Gowrishankar S, Veena A, Introduction to Python Programming, CRC Press 2. Mark Lutz, Learning Python, O'Reilly Media

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MCA- C352 Web Technologies Lab				
	L	T	P	C
	0	0	6	3

Lab objective:
The Lab covers the wide range of web technologies both client side and server side to provide the exposure to the students to develop Rich Internet Applications using them. It covers the basics WWW, client-side technologies like HTML, CSS and DHTML including JavaScript, server-side scripting with PHP and database connectivity using PHP and related technologies.

Lab outcomes:

1. Describe the concepts of WWW including browser and HTTP protocol.
2. List the various HTML tags and use them to develop the user-friendly web pages.
3. Define the CSS with its types and use them to provide the styles to the web pages at various levels.
4. Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications.
5. Use the JavaScript to develop the dynamic web pages.
6. Use server-side scripting with PHP to generate the web pages dynamically using the database connectivity.
7. Develop the modern Web applications using the client and server-side technologies and the web design fundamentals. .

Introduction to WWW: Protocols and programs, secure connections, application and development tools, the web browser, what is server, choices, setting up UNIX and Linux web servers, Logging users, dynamic IP

Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation

Introduction to HTML: The development process, Html tags and simple HTML forms, web site structure,

Introduction to XHTML: XML, move to XHTML, Meta tags, Character entities, frames and frame sets inside browser.

Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2

JavaScript: Client-side scripting, what is Javascript, how to develop Javascript, simple Javascript, variables, functions, conditions, loops and repetition, Javascript and objects, Javascript own objects, the DOM and web browser environments, forms and validations

DHTML: Combining HTML, CSS and Javascript, events and buttons, controlling your browser

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, using XML with application.

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XML, XSL and XSLT: Introduction to XSL, XML transformed, simple example, XSL elements, transforming with XSLT

Ajax: Introduction, advantages & disadvantages, Purpose of it, ajax based web application, alternatives of ajax

PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Cookies and Sessions, Object Oriented Programming with PHP

Databases: Basic command with PHP examples, 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, PHP myadmin

Recommended Books:

1. Ralph Moseley and M. T. Savaliya, Developing Web Applications, Wiley-India Pvt. Ltd.
2. B.M. Harwani, Developing Web Applications in PHP and AJAX ,Tata McGraw Hill

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MCA- C451 Major Project

L	T	P	C
0	0	40	20

This course can be completed in-house or at any industry as decided by the departmental committee based on the merit of the project and shall consists of the following components:

Sr. No.	Component	Assessment	Marks
1.	Problem Identification and Seminar	Internal Through Departmental Committee	100
2.	Dissertation	Internal Through Departmental Committee	100
3.	Presentation and Viva - voce	External	200

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