Syllabus of I Semester MCA programme,
CHOICE BASED CREDIT SYSTEM(CBCS)
(According new regulations w.e.f. 2020-21)

Semester-I	I SEMSTER MCA w.e.f.2020-21								
	Course	Subject Name	Teaching Hrs per week	Practical Hrs/ week	Examination				Credits
					Duration (Hrs.)	Marks			
						Theory/ Practical	IA	Total	
Core Subject	20MCACS 1.1	Discrete Mathematical Structures	4	--	3	80	20	100	4
	20MCACS 1.2	Object Oriented Programming with C++	4	--	3	80	20	100	4
	20MCACS 1.3	Unix System Programming	4	--	3	80	20	100	4
	20MCACS 1.4	Data Structures and Algorithms	4	--	3	80	20	100	4
	20MCACS PL 1.5	Unix System Programming Lab	--	4	3	80	20	100	3
	20MCACS PL 1.6	Data structure and Algorithm using C++ Lab	--	4	3	80	20	100	3
Soft Core / Specialization/ Optional	20MCASC 1.7	Computer System Architecture	4	--	3	80	20	100	4
Bridge Course	20MCABC 1.8	C Programming	4	-	3	80	20	100	-
		Total	**24**	**8**				**800**	**26**

CS: Core Subject SC: Soft Core PL: Practical

Bridge Course(20MCABC 1.8**)** is a non credit paper to be offered only for non-Computer Science background students(BSc ,BA and BCOM). However such students have to obtain eligibility both in Semester end examination and I.A as per the University Norms

20MCACS 1.1 : Discrete Mathematical Structures	
Teaching:4 hrs./week **Credits:04Hrs.:52**	**Max. Marks:80** **I. A. Marks:20**

UNIT I 10 Hrs

Sets and Logic: Sets, propositions, conditional propositions and logical equivalence, arguments and rules of inference, quantifiers, nested quantifiers.

UNIT II 12 Hrs

Proofs: Principles of mathematical induction, Functions,

Relations: relations, operations on relations, Properties of relations, equivalence relations, matrices of relations, Partially ordered sets, lattices, finite Boolean algebra, functions on Boolean algebra.

UNIT III 10 Hrs

Graph Theory: Introduction of Graphs and digraphs, Paths and Cycles, Hamiltonian Cycles, adjacency and incidence matrices, vertex colouring, representations of graphs, isomorphisms of graphs, planar graphs.

UNIT IV 10 Hrs

Trees: Terminology and characterizations of trees, spanning trees, minimal spanning trees, shortest-path algorithm, binary trees, tree traversals, decision trees, isomorphism of trees.

UNIT V 10 Hrs

Semi Groups and Groups: Semigroups, products and quotients of semigroups, groups, products and quotients of groups.

Groups and coding: Coding of Binary information and error detection, decoding and error detection.

Text Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, 5/e, Tata McGraw Hill.
2. Deo N., Graph theory with application to Engineering and Computer Science, Prentice Hall of India,
3. Kolman, Busby, Ross, Discrete Mathematical Structures, Pearson Education.

Reference Books:

1. J.P. Tremblay and R.Manohar, Discrete Mathematical structures with applications to Computer Science, Tata McGraw Hill.

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20MCACS1.2: Object Oriented Programming with C++

Teaching: 4 hrs./week **Max. Marks: 80**
Credits: 04 Hrs.: 52 **I. A. Marks: 20**

UNIT I 10Hrs

Overview of C++: Object Oriented Programming concepts, advantages, C++ program development environment, the C++ language standards, C++ as a superset of C.

Classes & Objects: classes, structure & classes, union & classes, inline function, scope resolution operator, static class members: static data member, static member function, passing objects to function, returning objects, object assignment, constructors & destructors, friend function, friend classes.

UNIT II 10Hrs

References & Dynamic Allocation Operators: array of objects, pointers to object, type checking C++ pointers, the this pointer, pointer to derived types, pointer to class members, reference parameter, call by reference and return by reference, passing references to objects, returning reference, C++'s dynamic allocation operators, allocating objects,

UNIT III 12Hrs

Overloading as polymorphism: function & operator overloading, operator overloading restrictions, operator overloading using friend function.

Namespaces: global namespace and namespace std, nested namespaces

Inheritance : base class access control, inheritance & protected members, protected base Class inheritance, inheriting multiple base classes, constructors, destructors & inheritance, execution of constructor & destructor functions, passing parameters to base class constructors, granting access, virtual base classes .

Virtual Functions & Polymorphism: virtual function, pure virtual functions, early vs. late binding.

UNIT IV 10Hrs

Templates and Exception Handling: Exception handling in C++, try, throw, catch sequence, multiple catch blocks, uncaught exceptions, catch-all exception handler, Templates: Reason for templates, compactness and flexibility, function template, class templates.

The C++ I/O System Basics: C++ Streams, the basic stream classes, c++ predefined streams, formatted I/O, file processing.

UNIT V 10Hrs

Overview of the Standard Template Library: The Standard Template Library, Design goals, Header files, STL components, STL Example: vectors, lists, maps, sets. Containers-Vector, Deque, List, Associative Containers, Set, Multiset, Map, Multimap. Iterators: Input iterators, Output iterators, Forward iterators, Backward iterators.

References:

1. Herbert Schildt, C++ The Complete Reference,Tata McGraw Hill Publication.
2. Al Stevens,C++ Programming, Wiely Publications.
3. B. A. Forouzon, R. F. Gilberge, Computer Science: A Structured Approach Using C++, Thomson Learning.
4. Stroubstrup B., The C++ Programming Language, Addison Wesley.
5. William H. Murray, Chris H. Pappas, Data structures with STL Prentice Hall.

20MCACS1.3: Unix System Programming	
Teaching: 4 hrs./week **Credits: 04 Hrs.: 52**	**Max. Marks: 80** **I. A. Marks: 20**

UNIT I 10Hrs

UNIX and ANSI Standards: The ANSI C Standard, The POSIX Standards, The POSIX.1 Standards. UNIX and POSIX APIs: The POSIX APIs, the UNIX and POSIX Development Environment, API Common Characteristics.

UNIT II 12Hrs

Files: File Types, The UNIX and POSIX File System, The UNIX and POSIX File Attributes, Inodes in UNIX System V, Application Program Interface to Files, UNIX Kernel Support for Files, Relationship of C Stream Pointers and File Descriptors, Directory Files, Hard and Symbolic Links.

File APIs: General File APIs (creat, open, write, read, close, fcntl), File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs, File Listing Program using APIs.

UNIT III 10Hrs

Processes: Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, waited, wait3, wait4 Functions, Race Conditions, exec Functions, Changing User IDs and Group IDs, Interpreter Files, System Function, Process Accounting, User Identification, Process Time

Process Relationships: Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tcgetpgrp, tISEtpgrp, and tcgetsid Functions, Job Control, Shell Execution of Programs, Orphaned Process Groups.

UNIT IV 10Hrs

Signals: The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction, The SIGCHLD Signal and the waitpid Function, The sigsetjmp and siglongjmp Functions, Kill, Alarm

UNIT V 10Hrs

Interprocess Communication: Introduction to IPC, Pipes, popen, pclose Functions, Coprocesses, FIFOs.

Advanced IPCs: Message Queues, Semaphores, Shared Memory

Reference Books:

1. W. Richard Stevens, Stephen A. Rago, Advanced rogramming in the UNIX Environment, 2/e, Addison Wesley Professional.
2. Terrence Chan, Unix System Programming Using C++, Prentice Hall India
3. Marc J. Rochkind, Advanced Unix Programming, 2/e, Pearson Education. Maurice. J.Bach, The Design of the UNIX Operating

20MCACS1.4: Data Structure and Algorithm	
Teaching: 4 hrs./week **Credits: 04 Hrs.: 52**	**Max. Marks: 80** **I. A. Marks: 20**

UNIT I 10Hrs

The Stack: Definition and examples, Primitive operations, Example, The stack as an ADT, Representing stacks in C, Implementing the pop operation, Testing for exceptional conditions, Implementing the push operation, Examples for infix, postfix, and prefix expressions, Basic definition and examples, Program to evaluate a postfix expression, Converting an expression from infix to postfix, Program to convert an expression from infix to postfix. Recursion and Queues: Recursive definition and processes, Factorial function, Multiplication of natural numbers, Fibonacci sequence, Binary search, Properties of recursive definition or algorithm. Recursion in C, Factorial in C, Fibonacci numbers in C, Binary search in C, Towers of Hanoi problem. The queue and its sequential representation, the queue as ADT, C implementation of queues, Insert operation, Priority queue, and Array implementation of a priority queue.

UNIT II 10Hrs

Lists: Linked lists, Inserting and removing nodes from a list, Linked implementation of stacks, getnode and freenode operations, Linked implementation of queues, Linked list as a data structure, Example of list operations, Header nodes, Lists in C, Array implementation of lists, Limitations of array implementation, allocating and freeing dynamic variables, Linked lists using dynamic variables, Queues as lists in C, Examples of list operations in C, Non integer and non- homogeneous lists, Other list structures: Circular lists, Stack as a circular list, Queue as a circular list, Primitive operations on circular lists, doubly linked lists. Trees: Binary trees, operations on binary trees, Applications of binary trees, Binary tree representation, Node representation of binary tree, Internal and external nodes, Implicit array representation of binary trees, Choosing a binary tree representation, Binary tree traversal in C, Threaded binary trees.

UNIT III 12Hrs

Graphs and Their Applications: Graphs: Definitions, Application of graphs, C representation of graphs, Traversal methods for graphs, Depth first traversal, Breadth first traversal. Algorithms: Notion of algorithm, Fundamentals of algorithmic problem solving, problem types, linear data structures, graphs, trees, sets and dictionaries. Analysis of algorithm efficiency: Analysis frame-work, asymptotic notations and basic efficiency classes, mathematical analysis of non-recursive and recursive algorithms, empirical analysis of algorithms

UNIT IV 10Hrs

Brute Force and Divide and Conquer: selection sort and bubble sort, sequential search and brute-force string matching, closest-pair and convex -hull problems, exhaustive search, merge sort, quick sort, binary search, binary tree traversals, Strassen's matrix multiplication. Decrease-and-Conquer and Transform-and-Conquer: Insertion sort, depth first search, topological sorting, presorting, Gaussian elimination, balanced search trees, heap sort, Horner's rule.

UNIT V 10Hrs

Dynamic programming: Computing a Binomial coefficient, Warshall's and Floyd's algorithms, the Knapsack problem and memory functions. Greedy technique-Prim's algorithm, Dijkstra'a algorithm, Huffman trees. Decision trees, P, NP, and NP-complete problems, challenges of numerical algorithms.

Reference Books:
1. A.M.Tenenbaum, Y, Langsam, M.J.Augustein, R.L.Kruse, B.P.Leung and C.L.Tondo, Data Structures using C, PHI.
2. Anany Levitin, The Design and Analysis of Algorithms, Pearson Education. References:
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education
4. Richard F. Gilberg, Behrouz A. Forouzan, Data structures-A Pseudocode Approach with C, Thomson Learning.
5. Aho A.V, Hopcroft J.E and Ullman, J.D., The Design and Analysis of Computer Algorithms, Addison, Wesley
6. Ellis, Horwitz, Sartaj Sahani and S. Rajashekaran, Computer Algorithms, Galgotia Publications Pvt. Ltd.

20MSCSC 1.7 : Computer System Architecture	
Teaching:4 hrs./week	**Max. Marks:80**
Credits:04Hrs.:52	**I. A. Marks:20**

UNIT I 12 Hrs

Computer Data Representation- Basic computer data types, Complements, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Register Transfer language, Register Transfer, Bus and Memory Transfers (Tree-State Bus Buffers, Memory Transfer), Arithmetic Micro-Operations, Logic Micro Operations, Shift Micro-Operations, Arithmetic logical shift unit

Basic Computer Organization and Design -Instruction codes, Computer registers, computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions,

UNIT II 10 Hrs

Basic Computer Organization and Design Instruction codes, Computer registers, computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input output and interrupt, Complete computer description, Design of Basic computer, design of Accumulator Unit

UNIT III 10 Hr

Programming The Basic Computer Introduction, Machine Language, Assembly Language, assembler, Program loops, Programming Arithmetic and logic operations, subroutines, I-O Programming.

Micro programmed Control: Control Memory, Address sequencing, Micro program Example, design of control Unit

UNIT IV 10 Hrs

Central Processing Unit Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC)

UNIT V 10 Hrs

Pipeline And Vector Processing Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction, Pipeline, RISC Pipeline, Vector Processing, Array Processors

Text Books:

1. M. Morris Mano, Computer System Architecture, Pearson publications.
2. Andrew S. Tanenbaum and Todd Austin, Structured Computer Organization, Sixth Edition, PHI

20MCACS BC 1.8: C Programming

Teaching:4hrs./week **Max. Marks:80**
Credits: 03. **I. A. Marks:20**

UNIT I 10 Hrs

INTRODUCTION TO C LANGUAGE : Pseudo code solution to problem, Basic concepts in a C program, Declaration, Assignment & Print statements, Data Types, operators and expressions etc, Programming examples and exercise.

UNIT II 10 Hrs

BRANCHING AND LOOPING: Two way selection (if, if-else, nested if-else, cascaded if-else), switch statement, ternary operator? Go to, Loops (For, while-do, do-while) in C, break and continue, Programming examples and exercises.

UNIT III 10 Hrs

ARRAYS AND STRINGS: Using an array, Using arrays with Functions, Multi-Dimensional arrays. String: Declaring, Initializing, Printing and reading strings, string manipulation functions, String input and output functions, array of strings, Programming examples and Exercises.

FUNCTIONS: Functions in C, Argument Passing – call by value, call by reference, Functions and program structure, location of functions, void and parameter less Functions, Recursion, Programming examples and exercises.

UNIT IV 10 Hrs

STRUCTURES AND FILE MANAGEMENT: Basic of structures, structures and Functions, Array of structures, structure Data types, type definition, Defining, opening and closing of files, Input and output operations, Programming examples and exercises.

UNIT V 10 Hrs

POINTERS AND PREPROCESSORS: Pointers and address, pointers and functions (call by reference) arguments, pointers and arrays, address arithmetic, character pointer and functions, pointers to pointer ,Initialization of pointer arrays, Dynamic memory allocations methods, Introduction to Preprocessors, compiler control Directives, Programming examples and exercises.

Text Books:

1. Brian W. Kernighan and Dennis M. Ritchie: The C Programming Language, 2nd Edition, PHI, 2012.
2. Jacqueline Jones & Keith Harrow: Problem Solving with C, 1st Edition, Pearson 2011.

Semester-II	II SEMSTER MCA w.e.f.2020-21								
	Course	Subject Name	Teaching Hrs per week	Practical Hrs/ week	Examination				Credits
					Duration (Hrs.)	Marks			
						Theory/ Practical	IA	Total	
Core Subject	20MCACS 2.1	Database Management Systems	4	--	3	80	20	100	4
	20MCACS 2.2	Programming using Java	4	--	3	80	20	100	4
	20MCACS 2.3	Data Mining Techniques	4	--	3	80	20	100	4
	20MCACSPL 2.4	Database Management Systems –Lab	-	4	3	80	20	100	3
	20MCACSPL 2.5	Programming using JAVA Lab		4	3	80	20	100	3
Soft Core / Specialization/ Optional	20MCASC 2.6	Data Communication and Computer Networks	4	--	3	80	20	100	4
Open Elective	20MCAOE 2.7	a. Big Data Analytics b. Internet Concepts and Web Design c. Management Information System	4	--	3	80	20	100	4
	Total		20	8				700	26

CS: Core Subject SC: Soft Core PL: Practical OE: Open Elective

20MCACS 2.1: Database Management System

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **12hrs**

Introduction: Data modeling for a database, abstraction and data integration, the three-level architecture, components of DBMS, advantages and disadvantages, data associations, data model classification, Entity-Relationship model.

UNIT II **10hrs**

File organization and storage, secondary storage devices, operations in file, heap files and sorted files, hashing techniques, type of single level ordered index, multi-level indexes indexes on multiple keys, other types of indexes.

UNITIII **12hrs**

The Relational Model: Relational database, relational algebra, relational calculus SQL- Data definition, relational database manipulation using SQL, views, embedded data manipulation.
Relational Database Design: Anomalies in a database, functional dependency, normal forms, lossless join and dependency, BCNF, normalization through synthesis, higher order normal forms.

UNITIV **10hrs**

Transaction processing, desirable properties of transaction, schedules and recoverability, serializability of schedules concurrency control, locking techniques, time stamp ordering multi version concurrency control, granularity of dataitems.

UNITV **8hrs**

Database recovery techniques based on deferred up data and immediate updating, shadow pages, ARIES recovery algorithm, database security and authorization, security issue access control based on granting/revoking of privileges, introduction of statistical database security.

Text Books:

1. Bipin C Desai, An Introduction to Database Systems, GalgotiaPublications.
2. Elmasri and Navathe, Fundamentals of Database Systems, AddisonWesley

References:

1. Silberschatz A, Korth H.F and Sudarshan S, Database System Concepts, Tata McGrawHill
2. S K Singh, Database Systems-Concepts, Design and Applications, PearsonEducation.
3. Bipin C. Desai, An Introduction to Database Systems, GalgotiaPublications.
4. Date, C. J., An Introduction to Database Systems, Addison-Wesley.

20MCACS 2.2: Programming using Java

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10 Hrs**

Introduction to Java programming, The Java Virtual Machine, Variables and data types, Conditional and looping constructs, Arrays.

UNIT II **10 Hrs**

Object-oriented programming with Java Classes and Objects, Fields and Methods, Constructors, Overloading methods, Garbage collection, Nested classes.

UNIT III **10 Hrs**

Inheritance, Overriding methods, Polymorphism, Making methods and classes final, Abstract classes and methods, Interfaces.

UNIT IV **12 Hrs**

Exception handling with try-throw-catch-finally constructs, The Exception class Packages, Package access, Documentation comments.

The Object class, Cloning objects, The JDK Linked List class, Strings, String conversions Working with types: Wrapper classes, Enumeration interface.

UNIT V **10 Hrs**

Applets, Configuring applets, Applet capabilities and restrictions, Basics of AWT and Swing, Layout Managers, Event Handling, The Action Listener interface, Panels, Classes for various controls, such as label, choice, list, , Checkbox, etc., Dialogs and frames, Using menus, Using the adapter classes, Graphics.

References:

1. HerbetSchidt and Dale Srien, Java Fundamentals - A comprehensive Introduction, TMH.
2. P.J. Deitel and H.M. Deitel, Java for Programmers, Pearsoneducation
3. P.J. Deitel and H.M. Deitel, Java: How to Program, PHI.
4. S. Malhotra and S. Choudhary, Programming in Java, Oxford Univ.Press.

20MCACS 2.3: Data Mining Techniques

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10 Hrs**

Introduction: Well posed learning problems, designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

UNIT II **10 Hrs**

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT III **10Hrs**

Artificial Neural Networks: Introduction, Neural Network representation, appropriate problems, Perceptrons, Backpropagation algorithm.

UNIT IV **10 Hrs**

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.

UNIT V **12 Hrs**

Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning, Reinforcement Learning: Introduction, Learning Task, Q Learning.

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.

20MCASC 2.6: Data Communication and Computer Networks

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **12Hrs**

Introduction: Data Communications, Networks, the internet, protocols and standards, network models– OSI model, TCP/IP protocol suite, addressing. Data and Signals: Periodic analog signals, digital signals, transmission impairment, data rate limits, performance

UNIT II **10 Hrs**

Physical Layer and Media: Analog transmission: Digital-to-analog conversion, analog-to-analog conversion. Multiplexing,
Transmission media – Guided media and unguided media.
Data Link Control: Framing, flow and error control,

UNIT III **10 Hrs**

Network Layer: Logical addressing – IPV4, IPV6, Address mapping–ARP, RARP,
Transport Layer: Process to Process Delivery, User Datagram Protocol, Transmission Control Protocol, SCTP, Congestion Control.

UNIT IV **10 Hrs**

Detection and Correction: Errors, redundancy, detection versus correction, Network Security-Security Services, Security in the Internet: Firewalls

UNIT V **10 Hrs**

Application Layer: Domain Name Space, DDNS, Remote Logging, Electronic Mail, and File Transfer, WWW, HTTP

Text Books:

Behrouza A Forouzan, Data Communications and Networking, McGrawHill.
Computer Networks - Andrew s. Tanenbaum, PearsonEducation.

References:

Data and Computer Communications, William Stallings, Pearson education
Data Communications, Computer Networks and Open Systems, fourth edition-Fred Halsall, adisonWesley.

20MCAOE 2.7(a): Big Data Analytics

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I 10Hrs

INTRODUCTION TO BIG DATA AND HADOOP Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets

UNIT II 10Hrs

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.

UNIT III 12Hrs

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.

UNIT IV 10Hrs

Hadoop Eco System 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.
Big SQL : Introduction

UNIT V 10Hrs

Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Text Book:

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

20MCAOE 2.7(b): Internet Concepts and Web Design

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I: **10hrs**

History of the internet, internetworking concepts, architecture, and protocol: switch, router, protocols for internetworking, internet address and domains. Introduction World Wide Web (WWW), working of web browser and web server, Web server and its deployment, N-tier architecture, services of web server, Common gateway interface (CGI), Uniform Resource Locator (URL), format of the URL, Hyper Text Transfer Protocol (HTTP), feature of HTTP protocol HTTP request-response model, Hyper Text Transfer Protocol Secure (HTTPS).

UNIT II: **12hrs**

Principles and planning of Web Design: Design for the medium: craft the look and feel, portable design, design for low band width, plan for clear presentation and easy access, Design the whole site: smooth transition, grids for visual structure, active white space, Design for the user: design for interaction, location, flat hierarchy, power of hypertext linking, content decision, Design for the screen, Planning the site, site specification, identity and content goal, analyzing audience, building website development team, filename and URLs, Directory structure, diagram the site.

UNIT III: **10hrs**

Introduction to HTML: Introduction to HTML, Elements of HTML syntax, Head and Body sections, Building HTML documents, Inserting text, images, hyperlinks, Backgrounds and Color Control, meta tags, ordered and unordered lists, Table Handling: Table layout & presentation, constructing tables in a web page, Frames: Developing Web pages using frames. Forms and its elements, special tags like COLGROUP,THEAD,TBODY, TFOOT,IFRAME,LABEL etc.

UNIT IV: **10hrs**

Introduction to JAVASCRIPT: JavaScript variables and data types, statement and operators, control structure object-oriented programming: Functions, Executing deferred scripts, objects, Messaging in a JavaScript: dialog boxes, Alert boxes, confirm boxes, prompt boxes, JavaScript with HTML, Events, Events Handlers, Forms, Forms array.

UNIT V: **10hrs**

Site Navigation and Publishing of Website: Crating usable navigation, Using text based navigation:Linking with text based navigation bar, linking to individual files, linking to document/external document fragments, contextual linking, Using graphics based navigation: using text image for navigation, using icon for navigation. Website Publishing: choosing an internet service provider, buying a domain name, using FTP to upload files, Website testing: testing consideration, user testing, feedback form. Refining and updating contents, working with search engines submitting URLs to search engines.

Text Books:-

1. Joel Sklar: Principles of Web Design, Thiomson Learning, Vikas Publisher.

2. Web Technologies- A computer science perspective By Jeffrey C. Jackson, Pearson Eduction .

3. Thomas A. Powell: HTML complete Refrence, TMH

4. The Complete Reference Web Design, Thomas A. Powell

5. Internet and Web Design, Vikas Gupta, DreamTech.

7. D Comer, The Internet Book, Second Edition, 2001, Prentice Hall of India.

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20MCAOE 2.7(c): Management Information System

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I 10Hrs

Management Information System(MIS)- concept, Definition and role of MIS, E-business enterprise, strategic management of business, information security challenges in e-enterprises, impact of information technology on society.

UNIT II 10Hrs

Decision making-concepts and process, MIS and decision making. Information- concepts, classificationvalue and methods of data and information collection, MIS and the information and knowledge.

UNIT III 10Hrs

Systems concept- types of systems, classes of systems, general model of MIS, systems analysis, systems development model-SSAD, MIS and systems analysis, Object oriented analysis, Object oriented, OOSAD development life cycle.

UNIT IV 10Hrs

Development of MIS, Decision Support systems and knowledge management, knowlwdge based expert systems, MIS and benefits of DSS, Enterprise resource planning systems-models and benefits.

UNIT V 12Hrs

Information Technology- data, transaction, and application processing; database concepts, RDBMS, client-server architecture, Data Warehouse-concept and architecture, business intelligence, data warehouse and MIS, models of e-business, electronic payment systems, security, MIS in web environment. Case studies.

References:

1. W. S. Jawadekar,Management Information Systems, 4th edition, McGraw Hill.

2. James O' Obrien and George M. Marakas, Management Information Systems, 10th edition, McGraw Hilledition.

3. Jaiswal and Mittal, Management Information Systems, Oxford University Press.

4. Turban and Aronson, Decision Support systems and intelligent systems, Pearson Education.

Syllabus of III Semester MCA programme,
CHOICE BASED CREDIT SYSTEM(CBCS)
(According new regulations w.e.f. 2020-21)

Semester-III	III SEMSTER MCA w.e.f.2021-22								
	Course	Subject Name	Teaching Hrs per week	Practical Hrs/ week	Examination				Credits
					Duration (Hrs.)	Marks			
						Theory/ Practical	IA	Total	
Core Subject	20MCACS 3.1	Software Engineering	4	--	3	80	20	100	4
	20MCACS 3.2	Web Programming	4	--	3	80	20	100	4
	20MCACS 3.3	Programming using Python	4	--	3	80	20	100	4
	20MCACSPL 3.4	Web Programming Lab	--	4	3	80	20	100	3
	20MCACSPL 3.5	Python Programming-Lab	--	4	3	80	20	100	3
Soft Core / Specialization/ Optional	20MCASC 3.6	Artificial Intelligence	4	--	3	80	20	100	4
Core Elective	20MCACE 3.7	a. Cyber Forensic & Security b. Internet of Things c. Pattern Recognition d. Embedded Systems e. Cloud Computing	4	--	3	80	20	100	4
	Total		20	8				700	26

CS: Core Subject SC: Soft Core PL: Practical CE: Core Elective Course

20MCACS 3.1:Software Engineering	
Teaching:4hrs./week	**Max. Marks:80**
Credits: 04Hrs.:52	**I. A. Marks:20**

UNIT I **10 Hrs**

Introduction to Software Engineering: FAQs about software engineering, systems engineering, system availability and reliability, software processes, project management.

UNIT II **10 Hrs**

Software Requirement: Software requirements, requirements engineering project, system models, critical systems specification, formal specification.

UNIT III **12 Hrs**

Software Design: Architectural designs, distributed system architectures, application architectures, object oriented design, real-time software design, user interface design.

UNIT IV **10 Hrs**

Software Development: Rapid software development, software reuse, component-based software engineering, critical systems development, software evolution.

UNIT V **10 Hrs**

Verification, Validation and Management: Software inspections, static analysis, verification and formal methods, software testing, critical systems validation.
Managing people, software cost estimation, quality management, process improvement, configuration management.

References:

1. Sommerville, Software Engineering, 8/e, Pearson Education.
2. Pressman S. Roger, Software Engineering, Tata McGraw Hill.
3. JalotePankaj, An integrated Approach to Software Engineering, Narosa Publishing House.
4. Shooman, Software Engineering, McGraw Hill.
5. C. Ghezzi, M. Jazayeri and D. Mandrioli, Fundamentals of Software Engineering, Prentice Hall of India

20MCACS 3.2: Web Programming	
Teaching:4hrs./week	**Max. Marks:80**
Credits: 04Hrs.:52	**I. A. Marks:20**

UNIT I **10 Hrs**

Overview: Web page Designing using HTML, Java Script-Object, names, literals, operators and expressions- statements and features-events - windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.-HTML5- CSS3- HTML 5 canvas. XML: DTD, Namespaces, XML schemas, displaying raw XML documents, Displaying XML documents with CSS, XSLT style sheets, XML processors

UNIT II **10 Hrs**

PHP : Server-side web scripting, Installing PHP, Adding PHP to HTML, Syntax and Variables, Passing information between pages, Strings, Arrays and Array Functions, Numbers, Basic PHP errors / problems. Database access with PHP and MySQL, PHP/MySQL Functions, Displaying queries in tables, Building Forms from queries, String and Regular Expressions, Sessions, Cookies and HTTP, Type and Type Conversions.

UNIT III **12 Hr**

Ruby on Rails: Origins and uses of Ruby, Scalar types and their operations, Simple input and output, Control statements, Arrays, Hashes, Methods, Classes, Code blocks and iterators, Pattern matching. Overview of Rails, Document requests, Processing forms, Rails applications with Databases, Layouts.

UNIT IV **10 H**

JDBC Overview – JDBC implementation – Connection class – Statements – Catching Database Results, handling database Queries. Networking– InetAddress class – URLclass- TCP sockets - UDP sockets, Java Beans –RM.

Java Servlets – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP.

UNIT V **10 Hrs**

Introduction to Ajax: Overview of Ajax; The basics of Ajax; Rails with Ajax.

References:

1. 1 Thomas Powell, Web Design The complete Reference, Tata McGrawHill
2. Thomas Powell, HTML and XHTML The complete Reference, Tata McGrawHill
3. PHP for the Web: Visual Quick Start Guide, 4th Edition, Peachpit Press
4. Beginning PHP 5.3 (Wrox, free ebook: http://it-ebooks.info/book/713/)
5. P.J. Deitel and H.M. Deitel, Java for Programmers, Pearson education
6. Chris Bates, Web Programming Building Internet Applications, 3rd Edition, Wiley India,
7. Pragmatic Dave Thomas, Andy Thomas, et al., Programming Ruby: The Pragmatic Programmer's Guide,

20MCACS3.3:Programming using Python

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10Hrs**

Installing Python, Simple program using Python, Expressions and Values, Variables and Computer Memory, error detection, Multiple line statements, Designing and using functions, functions provided by Python, Tracing function calls in memory model, omitting return statement. Working with Text: Creating Strings of Characters, Using Special Characters in Strings, Creating a Multiline String, Printing Information, Getting Information from the Keyboard.

UNIT II **10Hrs**

A Boolean Type , Choosing Statements to Execute, Nested If Statements , Remembering the Results of a Boolean Expression Evaluation , A Modular Approach to Program Organization, Importing Modules , Defining Your Own Modules, Testing Code Semi automatically Grouping Functions Using Methods: Modules, Classes, and Methods , Calling Methods the Object-Oriented Way, Exploring String Methods, Underscores.

UNIT III **12Hrs**

Storing Collections of Data Using Lists: Storing and Accessing Data in Lists, modifying Lists, Operations on Lists, Slicing Lists, Aliasing, List Methods, Working with a List of Lists. Repeating Code Using Loops: Processing Items in a List, Processing Characters in Strings, Looping Over a Range of Numbers, Processing Lists Using Indices, Nesting Loops in Loops, Looping Until a Condition Is Reached, Repetition Based on User Input, Controlling Loops UsingBreak and Continue Reading and Writing.

UNIT IV **10Hrs**

Files: Kinds of files, Opening a File, Techniques for Reading Files, Files over the Internet, Writing Files, and Writing Algorithms That Use the File-Reading Techniques, Multiline Records. Storing Data Using Other Collection Types: Storing Data Using Sets, Storing Data Using Tuples, Storing Data Using Dictionaries, Inverting a Dictionary, Using the In Operator on Tuples, Sets, and Dictionaries, Comparing Collections.

UNIT V **10Hrs**

Collection of New Information Object-Oriented Programming : Understanding a Problem Domain , Function “Isinstance,” Class Object, and Class Book , Writing a Method in Class Book, Plugging into Python Syntax: More Special Methods ,Creating Graphical User interface: Building a Basic GUI, Models, Views, and Controllers, Customizing the Visual Style Introducing few more Widgets, Object-Oriented GUIs, Keeping the Concepts from Being a GUI Mess.

Text Books:

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey , Jeffrey Elkner, 2015

Reference Books:

1. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr.
2. Exploring Python, Timothy A. Budd, McGraw Hill Education
3. Python for Informatics: Exploring Information, Charles Severance.
4. Learning Python, Fourth Edition, Mark Lutz, O’Reilly publication

20MCASC 3.6: Artificial Intelligence

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10 Hrs**

INTRODUCTION TO Al AND PRODUCTION SYSTEMS
Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II **10 Hrs**

REPRESENTATION OF KNOWLEDGE
Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III **10Hrs**

KNOWLEDGE INFERENCE
Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.

UNIT IV **10 Hrs**

PLANNING AND MACHINE LEARNING
Basic plan generation systems – Strips -Advanced plan generation systems – K strips - Strategic explanations -Why, Why not and how explanations. Learning- Machine

UNIT V **12 Hrs**

EXPERT SYSTEMS
Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

Text Books:

1. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.

Reference books

1. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig “AI – A Modern Approach”, 2nd Edition, Pearson Education
3. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013.

20MCACE 3.7 (a): Cyber Forensic & Security

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT 1: Understanding Cyber Forensics **12Hrs**

Computer forensics, Cyber forensics and Digital evidence, rules of evidence, Forensics analysis of e-mail- RFC282, Digital forensics life cycle, Chain of custody concept, Network forensics, Setting up a computer forensics laboratory, Computer forensics and steganography, Root kits, Information hiding, relevance of the OSI 7 layer model to computer forensics, Forensics and social networking sites: The security/privacy, Threats.

UNIT 2: Challenges in Cyber Forensics **12Hrs**

Technical challenges: understanding the raw data and its structure, The legal challenges in computer forensics and data privacy issues , Special tools and techniques - digital forensics tools, Special technique: data mining used in cyber forensics, Forensics auditing, Anti forensics.

UNIT 3: Security Principles and Practices **10Hrs**

Information system security principles, Threats and attacks, Classification of threats and assessing damages, Protecting information systems security, Information system security engineering process

UNIT 4: Security Threats **08Hrs**

Types of security threats- worms, viruses, Trojan horse, malware, malicious spyware, adware, botnet, spam, phishing, stack and buffer overflow

UNIT 5: Operating System Security **10Hrs**

Role of operating systems in information systems applications, Operating systems security, Patched operating systems, protected objects and methods of protection, Memory address protection, File protection mechanism

References:

1. Albert J. Marcella; Frederic Guillossou"**Cyber forensics: from data to digital evidence"** Hoboken, New Jersey: Wiley, 2012.

20MCACE 3.7 (b): Internet of Things

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10 Hrs**

Fundamentals of IoT: Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoTvs M2M.

UNIT II **10 Hrs**

IoT Design Methodology: IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

UNIT III **12Hrs**

Building IoT With Raspberry PI: Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services –

UNIT IV **10Hrs**

Building IoT with GALILEO/ARDUINO: Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks

UNIT V **10Hrs**

Case Studies and Advanced Topics: Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for IoT – Data Analytics for IoT – Software & Management Tools for IoT

References:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for
Linux Programmers”, Apress, 2014. 3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014

20MCACE 3.7 (c): Pattern Recognition

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I 08Hrs

Basics of Probability, Random Processes and Linear Algebra (recap): Probability: independence of events, conditional and joint probability, Bayes theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra.

UNIT II 10Hrs

Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors, singular values, singular vectors. Bayes Decision Theory : Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.

UNIT III 12Hrs

Parameter Estimation Methods : Maximum-Likelihood estimation :Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation. Parzen-window method. K-Nearest Neighbour method.

UNIT IV 10Hrs

Dimensionality reduction: Principal component analysis - it relationship to eigen analysis. Fisher discriminant analysis - Generalised eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorisation - a dictionary learning method..

UNIT V 10Hrs

Linear discriminant functions : Gradient descent procedures, Perceptron, Support vector machines - a brief introduction. Artificial neural networks: Multilayer perceptron - feedforwark neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

Text Book:

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

20MCACE 3.7 (d): Embedded Systems

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

Unit-I **10hrs**

Embedded System: Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems.

Unit-II **12hrs**

Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging

Unit-III **10hrs**

ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence.

Unit-IV **10hrs**

Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface.

Unit-V **10hrs**

Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex-M3 Programming using assembly and C language, CMSIS.

Text Books:

1. K. V. Shibu, "Introduction to embedded systems", TMH education Pvt. Ltd. 2009.
2. Joseph Yiu, ―The Definitive Guide to the ARM Cortex-M3‖, 2ndedn, Newnes, (Elsevier), 2010.

Reference Book:

James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.

20MCACE 3.7 (e): Cloud Computing

Teaching:4hrs./week **Max. Marks:80**
Credits: 04Hrs.:52 **I. A. Marks:20**

UNIT I **10 Hrs**

Cloud Computing Basics: Cloud Computing Overview, Applications, Intranets and the Cloud, First Movers in the cloud.

UNIT II **10 Hrs**

Organization and Cloud Computing with the Titans: When You Can Use Cloud Computing, Benefits, Limitations, Security Concerns, Regulatory Issues. – Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBM, Partnerships.

The Business Case for Going to the Cloud: Cloud Computing Services, How Those Applications Help Your Business, Deleting Your Datacenter, Salesforce.com, Thomson Reuters.

UNIT III **10 Hrs**

Hardware and Infrastructure: Clients, Security, Network, Services.

Accessing the Cloud: Applications, Web APIs, Web Browsers.

Cloud Storage: Overview, Cloud Storage Providers, Standards – Applications, Client, Infrastructure, Service, software.

UNIT IV **12 Hrs**

Software as a Services: Overview, Driving Forces, Company Offerings, Industries.

Software plus Services: Overview, Mobile Device Integration, Providers, Microsoft Online.

Developing Applications: Google, Microsoft, Intuit Quick Base, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management.

UNIT V **10 Hrs**

Local Clouds and Thin Clients: Virtualization in Your Organization, Server Solutions, Tin Clients, Cast Study: McNeilus Steel.

Migrating to the Cloud: Cloud Services for Individuals, Cloud Services Aimed at the Mid-Market, Enterprise-Class Cloud Offerings, Migration, Best practices and the future of cloud computing.

Text Books:

1. Anthony T. Vete, Toby J. Velte, Robert Elsenpeter, ―Cloud Computing A Practical Approach‖, McGraw-Hill, 2010.

References:

1. Barrie Sosinsky, ‖Cloud computing Bible‖, Wiley Publications, 1st Edition, 2011.
2. A. John Rhoton, ―Cloud computing explained‖, Recursive press, 2010.

Syllabus of IV Semester MCA programme,
CHOICE BASED CREDIT SYSTEM (CBCS)
(According new regulations w.e.f. 2020-21)

IV SEMSTER MCA w.e.f. 2021-22								
Course	Subject Name	Teaching Hrs per Week	Practical Hrs/week	Examination				Credits
				Duration (Hrs.)	Marks			
					Theory/ Practical	IA	Total	
20MCATS 4.1	Project/ Technical Seminar	-	--	--	--	100	100	2
20MCAPJ 4.2	Project (16 Weeks)	-	--	3	300	100	400	20
	Total						**500**	**22**

TS: Technical Seminar PJ: Project

Project / Technical Seminar:

I A marks shall be awarded by a research committee comprising of Chairman of the Department, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the programme shall be mandatory. The marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skills and performance in Question and Answer session in the ratio 50:25:25.

Students may be assigned to do literature survey of existing work on contemporary topics and present in front of the research committee (compulsory). Student shall highlight on the research gap and propose solution.

Project:

The candidate should carry out the project in any industry or R&D institution or educational institution under a guide/co-guide. The candidate has to present the work carried out before the examiners during the University examination. The work carried out should be free from plagiarism. The literature study may be clearly written which may be summary of existing project and highlight of what are the functionalities that are proposed to this project. Student shall indicate the different research papers, documents refereed as a part of the literature study. This is an individual project for a duration of minimum of 4 months or duration of the semester. Paper publication in an indexed journal/conference is compulsory as part of the project work.