SCHEME & SYLLABUS OF POSTGRADUATE DEGREE COURSE

Master of Computer Applications
I & II Semester

Effective for the students admitted in year 2021-22 and onwards.

Office: Bikaner Technical University, Bikaner
Karni Industrial Area, Pugal Road, Bikaner-334004
Website: https://btu.ac.in

MCA: Bridge Course

THEORY										
S.No.	Course		Contact hrs./week			Marks				Cr
	Code	Title	L	T	P	Exam Hrs.	IA	ETE	Total	
1	MCA-BC-110	Computer Fundamentals and Programming in C	3	0	0	3	20	80	100	3
Sub Total			**3**	**0**	**0**		**20**	**80**	**100**	**3**
PRACTICAL & SESSIONAL										
2	MCA-BC-111	C Programming Lab	0	0	4	3	60	40	100	2
Sub Total			**0**	**0**	**4**		**60**	**40**	**100**	**2**
TOTAL OF Bridge Course			**3**	**0**	**4**		**80**	**120**	**200**	**5**

- Students must score at least the minimum marks for the Bridge course, i.e., 40% in theory and practical separately. These marks, however, will not be added to the final score of the semester/program.
- For the Bridge course, only cleared or not cleared will be mentioned in the mark sheet. No separate certificate will be issued.
- Total Duration of Completion of MCA Program will be **Four** Semester with the maximum attempt of Four more semesters, and the same applies to the Bridge course
- No Grace marks for the bridge course
- Grace marks for MCA program subjects will be given as per university examination system likewise other PG program/s
- Exam paper pattern will be as follows
  Ten very small questions (2 marks each) of 20 marks (2 questions from each Unit)
  Five small questions (4 marks each) of 20 marks (1 question from each Unit)
  Five big questions of (8 marks each) 0f 40 marks (2 questions from each Unit with an OR option)

MCA First Year : I-Semester

THEORY										
S.No.	Course		Contact hrs./week			Marks				Cr
	Code	Title	L	T	P	Exam Hrs.	IA	ETE	Total	
1	MCA 121	Data Structures using C++	3	0	0	3	20	80	100	3
2	MCA 122	Database Management Systems	3	0	0	3	20	80	100	3
3	MCA 123	Web Development	3	0	0	3	20	80	100	3
4	MCA 124	Computer Networks	3	0	0	3	20	80	100	3
5	MCA 125	Mathematical Foundations of Computer Science	3	0	0	3	20	80	100	3
6	MCA 126	Software Project Management	3	0	0	3	20	80	100	3
Sub Total			**18**	**0**	**0**		**120**	**480**	**600**	**18**
PRACTICAL & SESSIONAL										
7	MCAL127	Data Structures Lab using C++	0	0	4	3	60	40	100	2
8	MCAL128	DBMS Lab	0	0	4	3	60	40	100	2
9	MCAL129	Web Development Lab	0	0	4	3	60	40	100	2
Sub Total			0	0	12		180	120	300	6
TOTAL OF I SEMESTER			**18**	**0**	**12**		**300**	**600**	**900**	**24**

MCA First Year : II-Semester

THEORY										
S.No.	Course		Contact hrs./week			Marks				Cr
	Code	Title	L	T	P	Exam Hrs.	IA	ETE	Total	
1	MCA 221	Python Programming	3	0	0	3	20	80	100	3
2	MCA 222	Operating Systems	3	0	0	3	20	80	100	3
3	MCA 223	Object Oriented Programming Using Java	3	0	0	3	20	80	100	3
4	MCA 224	Full Stack Development	3	0	0	3	20	80	100	3
5	MCA 225	Cloud Computing	3	0	0	3	20	80	100	3
6	MCA 226	Cyber Security and Digital Forensics	3	0	0	3	20	80	100	3
Sub Total			**18**	**0**	**0**		**120**	**480**	**600**	**18**
PRACTICAL & SESSIONAL										
7	MCAL227	Python Programming Lab	0	0	4	3	60	40	100	2
8	MCAL228	Object Oriented Programming Lab Using Java	0	0	4	3	60	40	100	2
9	MCAL229	Full Stack Development Lab	0	0	4	3	60	40	100	2
Sub Total			0	0	12		180	120	300	6
TOTAL OF I SEMESTER			**18**	**0**	**12**		**300**	**600**	**900**	**24**

SYLLABUS OF
POSTGRADUATE DEGREE COURSE

Master of Computer Applications
I & II Semester

Effective for the students admitted in year 2021-22 and onwards.

Syllabus Bridge Course

MCA-BC-110: Computer Fundamentals and Programming in C

Credit: 3		Max Marks: 100 (IA :20, ETE:80)
3L+ 0T+ 0P		End Term Exams: 3hr
S.No.	**Contents**	**Hours**
1	**Introduction to Computers:** Introducing and Interacting with Computers, Computer Organization, Number System, and Computer codes, Computer Arithmetic, Boolean Algebra, and IO Devices.	7
2	**Introduction to Memory and Languages:** Processor And Memory, Types of Storage Devices, Computer Software and types, Basics of Programming, Programming Languages. Language Elements, Algorithms, and Flowcharts.	8
3	**Problem Solving with C Programming:**History, Execution of C Program, Constants, Variables and Keywords, Data types, Expressions, constants, variables, Operators, Operator Precedence and associativity, data input and output, Formatted Console I/O Functions, Conversion Specifications, assignment statements, conditional statements, Looping Statements, Storage Classes	8
4	**Array and Modular Programming :**Introduction to Function, Functions with Simple Output Parameters, Passing Values between Functions, Multiple Calls to a Function, Parameter Passing by Value v/s Parameter Passing by Reference, Recursion, and stack **Arrays:** Declaring and Referencing Arrays, Array Subscripts, Using for Loops for Sequential Access, Multidimensional Arrays, Passing arrays as arguments	9
5	**Structures, Unions, Strings and Pointers :**Structures & Unions- definition, Processing structures – Passing structures to a function. Pointers: Operations on Pointers – Pointers to Functions, Functions Returning Pointers, Arrays of pointers. String handling	8
	Total	**40**

Suggested Books:

- Peter Norton,“ Introduction to Computers,” 6th Edition,2009.
- Yashvant Kanetkar, “Let Us C”, BPB Publications, 13th edition, 2012.
- S Prasad, K.R Venugopal, “Mastering C,” Tata McGraw Hill, 2006.
- E. Balaguruswamy, “Programming in ANSI C,” Tata McGraw Hill, 6th Edition, 2012.
- Pradeep K Sinha, Priti Sinha, “Computer Fundamentals,” 6th Edition, 2003.
- Bayron Gottfried, “Schaum’s Outline of Programming with C”, 4th Edition, 2018 (Paper Back).
- Kernighan and Ritchie, “The C Programming Language,” Prentice-Hall, 2015 (Paper Back).

Syllabus Bridge Course

MCA-BC-111: C Programming Lab

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+ 0T+ 4P	End Term Exams: 3hr

List of Experiments

Simple C Programs to Learn

- Data types & Expressions, Constants & Variables
- Operators, Operator Precedence and associativity
- Keywords & Identifiers
- Storage Classes
- Conditional statements
- Looping Statements

Array and Modular Programming

- Basic Array programs using for loop
- User-defined functions
- Recursion
- Programs on Two-dimensional Arrays, Passing arrays as arguments

String handling

- Programs based on String Functions and Character Operation
- Programs based on an array of Pointers to Strings

Structure and Pointers

- Programs based on Structures & Unions
- Programs based on pointers (arithmetic operations on Pointer, arrays with pointers).
- Programs of Pointers to structures and Array of structures

MCA 121 : Data Structure Using C++

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction to C++:** OOPS Paradigm**,** Identifier, and keywords, constants, C++ operators, type conversion, Variable declaration, statements, expressions, Input and output, Conditional expression, loop statements, breaking control statements, Classes and objects, constructors and destructors, function and operator overloading, inheritance, Virtual Function, friend function, this Pointer, dynamic type information, and polymorphism.	**8**
2	**Arrays:** Single Dimension, Multi Dimensions, Memory Representation, Address Calculation, Sparse Matrices- Types, Representation and Operations, Linear and Binary Search, Selection Sort, Bubble Sort, Insertion Sort, Radix Sort, Merge Sort, Shell Sort. C++ streams, console stream classes, formatted and unformatted console I/O operations, manipulators, File streams, file pointers and manipulations file I/O, Exception handling, dynamic memory allocation.	**8**
3	**Introduction to Linear Data Structures:** Introduction and Classification of Data Structures, Abstract Data Types .**Linked List:** Dynamic Memory versus Static Memory Allocation, Types and Operations Singly Linked List, Doubly Linked List, Header Linked List, Circular Linked List, Applications Polynomial Arithmetic**.Stacks and Queues:** Introduction and Implementation, Types of Queues and Applications, Multi Stacks and Multi Queues, Applications of Stacks- Need, Evaluation, and Conversion between Polish and Reverse Polish Notations, Quicksort, Recursion.	**8**
4	**Non-Linear Data Structures:** **Tree:** Notations & Terminologies, Binary Trees, Binary Search Trees, Basic Operations, Tree Traversals (Recursive and Stack Based non-Recursive), Threaded Binary Tree, Tree Sort, Tries. **AVL Trees:** Properties, Operations- Insertion, and Deletion. **M- Way Trees:** General Concept, B Trees, B+ Trees, and B* Trees. **Heaps**: Structural Properties, Heapify, Heap Sort, Priority Queue Implementation.	**9**
5	**Shortest Path Algorithms**: Single Source and All Pairs- Dijkstra's Algorithm. **Hashing:** Hash Table, Hash Functions, Collision Resolution- Chaining and Open Addressing. **Graphs** Terminology & Representations, Graphs & Multi-graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees	**8**
	Total	**42**

Suggested Books:

- Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++," Pearson Education India, Fourth Edition, 2014.
- Yashavant Kanetkar, Data Structures Through C++ By Kanetkar, BPB Publications
- K.R. Venugopal, Raj Kumar Buyya, "Mastering C++," McGraw-Hill, 2017
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to ALGORITHMS," PHI, India Second Edition.
- E. Balagurusamy, "Object-Oriented Programming with C++," Tata McGraw Hill, 2006
- Yahwant Kanetkar, "C++ Programming", BPB Publication
- Mary E. S. Loomis, "Data Management and File Structure," PHI, Second Edition, 2009.

E. Horowitz &Sahni, "Fundamental Data Structure," Galgotia Book Source, 2007.

MCA 122 : Database Management Systems

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Basic concepts:** Database & database users, characteristics of the Database, Database systems, concepts and architecture, Data Models, Schemas & Instances, DBMS architecture & data independence, Overview of hierarchical, Network & Relational Data Base Management Systems. **Data Modelling using the Entity-Relationship Model:** ER model concepts, notation for ER diagram, mapping constraints, Concepts of keys, Extended ER model – Generalization, Specialization, Aggregation, ER diagram to tables Mapping	9
2	**Relational Model:** Relational data model, **Relational integrity constraints:** Entity Integrity, Referential integrity, Domain Constraints, Key constraints. **Relational Algebra, Relational calculus:** Tuple Relational Calculus and domain Relational calculus. **Introduction to SQL**: SQL commands and types: DML, DDL, DCL, TCL. SQL Datatypes and Literals, Operators in SQL. **Database Objects**: Table, View, Sequence, Index, Synonym, Queries. **Advanced SQL:** Functions: Single Row Functions, Aggregate functions, Sub Queries, Join Operations. **Set Operations**: Unions, Intersection, Minus.	9
3	**Normalization:** Functional dependencies, Normal forms- 1NF, 2NF, 3NF, BCNF, join Dependencies and multi-valued dependencies. **PL/SQL Programming:** Introduction to PL/SQL, Structure of PL/SQL Block, PL/SQL language: Operators, Control Structure, Cursors, Triggers, Procedures, and functions.	8
4	**Transaction processing concept:** Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery From transaction failures, log-based Recovery, checkpoints, deadlock handling.	7
5	**Concurrency control techniques:** Concurrency control, locking techniques, timestamp Ordering, The granularity of data items, Recovery from catastrophic failures. Concepts of object-oriented database management systems, Distributed DataBase Management Systems, Overview of Database Security Concepts.	7
	Total	**40**

Suggested Books:

- Elmasri, Navathe, "Fundamentals of Database Systems," Addison Wesley, 7th Edition, 2016.
- Korth, Silberschatz, Sudarshan, "Database Concepts," McGraw Hill, 6th Edition, 2010.
- Thomas Connolly and Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation, and Management, Addison Wesley, 6th Edition, 2014.
- Ramakrishnan, Gehrke, "Database Management System," McGraw Hill, 3rd Edition, Jan 2007
- Date C J, "An Introduction to Database Systems," Addison Wesley, 8th Edition 2003
- Bipin C. Desai, "An Introduction to Database Systems," Galgotia Publication, Revised Edition, 2010
- Majumdar & Bhattacharya, "Database Management System," TMH, 2005.
- Paul Beynon Davies, "Database Systems," Palgrave Macmillan, 3rd Edition, 2003

MCA 123: Web Development

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Overview of Internet:** Evolution of Internet, Concept of Internet and WWW, Introduction to TCP/IP. HTML: HTML Elements, Semantic Elements, HTML Forms. CSS: Introduction, Selectors, Styling: Borders, Background, Text Effects, Text, Fonts, Transitions, Transforms, Animation, Multiple Columns, User Interface, and CSS Filters. Web Servers: System Architecture, Configuring and Accessing IIS Web Servers, HTTP, Protocol-Request and Response.	8
2	**JavaScript:** Introduction, Operators, Conditional Statement, Looping Statement, Functions in JavaScript, JavaScript and Objects, commonly used objects in JavaScript, the DOM and web browser environments, forms, and validations. DHTML: Combining HTML, CSS, and JavaScript, Events and Buttons, Controlling the browser. What is Open Source Framework, Most Popular Open Source Frameworks, and their key features, Open Source Server-Side Web Development Framework - .NET, Working Architecture, Components of .NET Framework: CLI, CTS, CLS, CLR and CLI Framework Class Library (FCL), ASP.NET Using C#, Web Form, Running Web Application using Server Controls Buttons, Textbox, Label, Checkbox, Checkboxlist, Radiobutton, Radiobuttonlist, ListBox, Calendar Control, AdRotator Control, Form Validation using Server Validation Controls.	10
3	**What is Open-Source Framework**, Most Popular Open-Source Frameworks, and their key features, Open-Source Server-Side Web Development Framework - .NET, Working Architecture, Components of .NET Framework: CLI, CTS, CLS, CLR, and CLI Framework Class Library (FCL), ASP.NET Using C#, Web Form, Running Web Application using Server Controls Buttons, Textbox, Label, Checkbox, Checkboxlist, Radiobutton, Radiobuttonlist, ListBox, Calendar Control, AdRotator Control, Form Validation using Server Validation Controls.	8
4	**The architecture of ADO.NET,** Connection Class, Command Classes, Data Adapter Class, Creating a Connection to Database, Displaying a Dataset, Grid View, Accessing Data with Data Readers and SQL Data Reader, Single-Page Applications (SPAs): Build Modern, Responsive Web Apps with ASP.NET, Understanding of Model–view–controller (MVC) and Model-View-View Model (MVVM) pattern.	8
5	**AJAX**: Understanding the need for Ajax, Introduction to Ajax, Cross-Browser DOM, Advantages and Disadvantages, Ajax the jQuery way: using load, post, get functions, ASP.NET Ajax, Client-Side Technologies, Server Side Technologies, Building ASP.NET Ajax applications. **jQuery**: Introduction, Selecting Elements, Modifying Elements, Event Handling, jQuery UI **Working with ASP.NET MVC:** Introduction to MVC, Comparison ASP.NET webform Application and ASP.NET MVC, MVC Architecture, Developing interactive web applications.	**8**
	Total	**42**

Suggested Books:

- Ivan Bay Ross, "HTML, DHTML, Javascript, Perl CGI," BPB Publication, 4th Revised Edition, 2010.
- Herbert Schildt, "C# 4.0 The Complete Reference", McGraw-Hill Education, 1st Edition, 2010.
- Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web: How to Program," Pearson, 5th Edition, 2018.

- Jason N. Gaylord, Christian Wenz, Pranav Rastogy, Todd Miranda, Scott Hanselman, "Professional ASP.NET 4.5 in C# and VB", Wrox Publication, 1st Edition, 2013.
- James L Mohler and Jon Duff, "Designing Interactive Web Sites," Delmar Thomson Learning, 1st Edition, 2000.
- John Pollock, "JavaScript: A Beginner's Guide," TMH, 5th Edition, 2020.
- Stephen Walther, Kevin Hoffman, Nate Dudek, "ASP.NET 4.0 Unleashed", Pearson Education, 1st Edition, 2010.
- Jess Chadwick, Todd Snyder, Hrusikesh Panda, "Programming ASP.NET MVC 4", O'Reilly Media, 1st Edition, 2007.

MCA 124 : Computer Networks

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Networking Fundamentals:** Introduction, Data & Information, Data Communication-Characteristics of Data Communication, Components of Data Communication, Data Representation, Data Flow-Simplex, Half Duplex, Full Duplex, Computer Network- Categories of a network, Protocol- Elements of a Protocol, Networking Standards, Reference Models- OSI Model, TCP/IP Model, Comparison of OSI and TCP/IP Model.	8
2	**The Physical Layer**: Transmission Media- Guided & Unguided, PSTN: Structure of the Telephone System, Data & Signals Data types, Signal types- Analog & Digital, Modulation Techniques, Modem, Cable Modem, Protocols: DSL, ISDN. The Data Link Layer Design Issues Framing, Error Control-Error Detection, Correction, Flow Control, Protocols: FDDI, CDDI, Frame Relay, ATM, 802.11, PPP, HDLC.	8
3	**The Medium Access Sub-Layer**:Multiple Access Protocols: ALOHA, CSMA, Ethernet: Switched Ethernet, Fast Ethernet, Gigabit Ethernet, DLL Switching: Internetworking, Repeaters, Hubs, Bridges, Switches, Routers, Gateways, Virtual LANs.	8
4	**The Network Layer:**Design Issues, Routing Algorithms: Link State Routing, Distance Vector Routing, Flooding, routing Protocols: RIP, IGRP, EIGRP, OSPF, Internetworking: Tunneling, Fragmentation, IPV4, IPV6 Basics, BGP. The Transport Layer Protocols: UDP, TCP, Headers	8
5	**The Application Layer:** DNS: The DNS Name Space, Name Servers-Mail: SMTP, POP3, HTTP, FTP, Telnet, Network Management: SNMP. Network Security Cryptography: Encryption, Decryption, Private/Public Key, Digital Signatures, SSL, Firewalls, PGP, S/MIME.	8
	Total	40

Suggested Books:

- Forouzan, B.A, 2009, Data Communications and Networking, 4th Edition, Tata McGraw Hill Education.
- Tanenbaum, A.S, 2010, Computer Networks, 3rd Edition, Pearson Education.
- Douglas E. Comer, Internet Working with TCP/IP Volume – I, Fifth Edition, Prentice-Hall,2008.
- W. Richard Stevens, Bill Fenner, and Andrew M. Rudoff, Unix Network Programming, Vol.1: The Sockets Networking API, Third Edition, Addison-Wesley Professional, 2003.

MCA 125: Mathematical Foundations of Computer Science

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Set Theory:** Sets and Elements, Universal Set, Empty Sets and Subset, Venn Diagrams, Set Operation, Algebra of Sets and Duality, Finite and Infinite Sets and Counting Principle, Classes of Sets, Power Sets, Partition, Mathematical Induction, Multi Sets, Logic and Propositional Calculus-Propositions and Compound Propositions, Basic logic operation, Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Logical Implication, Normal Forms.	9
2	**Relations:** Product Set, Relation, Pictorial Representation of Relations, Matrix Representations, Type of Relations. Closure Properties, Equivalence Relations, Functions, and Algorithm: Function, Mapping, Recursively Defined Function, Cardinality, Algorithm and Functions, Complexity of Algorithms.	8
3	**Order Sets:** Properties, Hasse Diagram, Consistent Enumeration, Supremum and Infimum, Isomorphic Order Sets, Well Order Sets. Boolean Algebra- Basic Definition, Duality, Basic Theorems, Sum of Products Form, Logic Gates and Circuits, Karnaugh Map. Counting: Basic Counting Principle, Factorial Notations, Binomial Coefficients Pascals's Triangle, Binomial Theorem, Permutations, Combinations, Pigeonhole Principle, Ordered and Unordered Partitions.	9
4	**Graph:** Directed and Undirected graph, multigraph, Sub Graph, Isomorphic & Homomorphic Graph Hamilton Graphs, Complete, Regular and Bipartite Graphs, Tree Graphs. Basic Definitions, Sequential Representation of Directed Graph, Digraph and Relations, Adjacency Matrix, Warshall's Algorithm. Linked Representation of Directed Graph, Depth First Search(DFS) and Breadth-First Search(BFS), Binary Tree, Rooted Tree, Spanning Tree, Kruskal's and Prims Algorithms.	8
5	**Iterative methods:** Newton-Raphson method. Solutions of linear system by Gaussian, Gauss-Jordan, and Gauss-Seidel methods. Interpolation: Newton's divided difference formula. Newton's forward and backward difference formulae, Numerical Differentiation and Integration: Numerical differentiation with interpolating polynomials, Numerical Integration by Trapezoidal and Simpson's 1/3rd rule. Double integrals using Trapezoidal and Simpson's rules. Runge-Kutta method of order four for first and second-order differential equations.	8
	Total	42

Suggested Books:

- Discrete Mathematics, Schaumd's Series by Seymour Lipschutz, Marc Lipson, Tata McGraw Hill
- Discrete Mathematics by Vinay Kumar (BPB)
- Numerical Methods by Balagurusamy, E., Tata McGraw Hill.
- Numerical methods for scientists and Engineers by Sankara Rao, K., Prentice – Hall of India.
- David Makinson, "Sets, Logic, and Maths for Computing," Springer Indian Reprint, 2011.
- Edgar Goodaire," Discrete Mathematics with Graph Theory" Pearson Education
- Bernard Kolman. Robert Busby. Sharon C. Ross," Discrete Mathematical Structures (Classic Version), 6th Edition", Pearson Education.

MCA 126 : Software Project Management

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**An Overview of Software Project Management:** Introduction to Project, Project Management, Difference between Software Engineering & Software Project Management. An Overview of IT Project Management: Define project, project management framework, The role of Project Manager, Systems View of Project Management, Stakeholder Management, Leadership in Projects: Modern Approaches to Leadership & Leadership Styles.	**8**
2	**Software Process Models:** Project phases and the project life cycle, Waterfall Model, Evolutionary Process Model: Prototype and Spiral Model, Incremental Process model: Iterative approach, RAD model, Agile Development Model: Extreme programming, Scrum.	**7**
3	**Types of Requirements**, Feasibility Study, Requirement Elicitation Techniques: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), **Requirement Analysis and Design:** Data Flow Diagram (DFD), Data Dictionary, Software Requirement Specification (SRS). Object-Oriented Analysis and Design: UML Overview, The Nature and Purpose of Models, UML diagrams (Use Case diagram, Activity Diagram, Class & Object Diagram, Sequence Diagram, State Transition Diagram, Deployment Diagram).	**8**
4	**Software Project Planning & Software Cost Estimation**: Business Case, Project selection and Approval, Project charter, Project Scope Management, Creating the Work Breakdown Structures (WBS). Software Estimation: Size Estimation: Function Point (Numericals). Cost Estimation: COCOMO (Numericals), COCOMO-II (Numericals) till Early design model	8
5	**Project Scheduling and Procurement Management:** Relationship between people and Effort: Staffing Level Estimation, Effect of schedule Change on Cost, Project Schedule, Schedule Control, Critical Path Method (CPM) (Numericals), Basics of Procurement Management, Change Management. **Software Risk Management:** Identify IT Project Risk, Risk Analysis and Assessment, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation	**9**
	Total	**40**

Suggested Books:

- Software Engineering, 5th and 7th edition, by Roger S Pressman, McGraw Hill publication.
- Managing Information Technology Project, 6edition, by Kathy Schwalbe, Cengage Learning publication.
- Information Technology Project Management by Jack T Marchewka Wiley India publication.
- The Unified Modelling Language Reference manual, Second Edition, James Rambaugh, Iver Jacobson, Grady Booch, Addition- Wesley.
- Software Engineering 3rd edition by KK Agrawal, Yogesh Singh, New Age International publication.
- Object-Oriented Modeling and Design with UML, Michael Blaha, James Rumbaugh, PHI(2005).

MCAL 127: Data Structures Lab Using C++

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No.	List of Experiments
1.	Write a C++ program to implement recursive and non-recursive i) Linear search ii) Binary search
2.	Write a C++ program to implement i) Bubble sort ii) Selection sort iii) quick sort iv) insertion sort
3.	Write a C++ program to implement the following using an array. a) Stack ADT b) Queue ADT
4.	Write a C++ program to implement list ADT to perform the following operations Insert an element into a list. Delete an element from a list Search for a key element in a list count number of nodes in a list
5.	Write C++ programs to implement the following using a singly linked list. Stack ADT b) Queue ADT
6.	Write C++ programs to implement the deque (double-ended queue) ADT using a doubly-linked list.
7.	Write a C++ program to perform the following operations: Insert an element into a binary search tree. Delete an element from a binary search tree. Search for a key element in a binary search tree.
8.	Write C++ programs for implementing the following sorting methods a) Merge sort b) Heap sort
9.	Write C++ programs that use recursive functions to traverse the given binary tree in Preorder b) inorder and c) postorder.
10.	Write a C++ program to perform the following operations Insertion into a B-tree b) Deletion from a B-tree
11.	Write a C++ program to perform the following operations Insertion into an AVL-tree b) Deletion from an AVL-tree

Suggested Books:

- Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++,” Pearson Education India, Fourth Edition, 2014.
- Yashavant Kanetkar, Data Structures Through C++ By Kanetkar, BPB Publications
- K.R. Venugopal, Raj Kumar Buyya, “Mastering C++," McGraw-Hill, 2017
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to ALGORITHMS,” PHI, India Second Edition.
- E. Balagurusamy, "Object-Oriented Programming with C++," Tata McGraw Hill, 2006
- Yahwant Kanetkar, ”C++ Programming”, BPB Publication
- Mary E. S. Loomis, “Data Management and File Structure,” PHI, Second Edition, 2009.
- D.S Malik, “Data Structures using C++,” Cengage Learning, 2nd Edition, 2009
- E. Horowitz &Sahni, “Fundamental Data Structure,” Galgotia Book Source, 2007.

MCAL 128: DBMS LAB

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No.	List of Experiments
1.	SQL data types, Operators, Literals, Constraints
2.	DDL Commands: Create Tables/Create Synonym /Create index /Views / Alter /
3.	Drop/Truncate/Comment/Rename/DBCC (Database Console Commands)
4.	DML Commands: Insert / Update / Delete / Merge/Lock Table
5.	TCL Commands: Commit / Rollback / Save-Points /Set Transaction
6.	DCL Commands: Grant / Revoke/Deny
7.	Simple Queries: Select / From / Where
8.	Group By/Having Clause/ Order By clause
9.	SQL Operators: Arithmetic / Logical /In / Like / Between
10.	Functions: Aggregate / Numeric / String / Date & Time / Logical
11.	Joins: Equi-Join / Natural Join / Self Join / Inner Join / Outer Join
12.	Unions / Intersection / Minus
13.	Subqueries or Nested Queries
14.	PL/Sql : Basic/Cursor/Trigger

Suggested Books:

- Elmasri, Navathe, "Fundamentals of Database Systems," Addison Wesley, 7th Edition, 2016.
- Korth, Silberschatz, Sudarshan, "Database Concepts," McGraw Hill, 6th Edition, 2010.
- Thomas Connolly and Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation, and Management, Addison Wesley, 6th Edition, 2014.
- Ramakrishnan, Gehrke, "Database Management System," McGraw Hill, 3rd Edition, Jan 2007
- Date C J, "An Introduction to Database Systems," Addison Wesley, 8th Edition 2003
- Bipin C. Desai, "An Introduction to Database Systems," Galgotia Publication, Revised Edition, 2010
- Majumdar & Bhattacharya, "Database Management System," TMH, 2005.

Paul Beynon Davies, "Database Systems," Palgrave Macmillan, 3rd Edition, 2003

MCAL 129: Web Development Lab

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No.	List of Experiments
1.	Program to Implement Basic Html Tags.
2.	Program to Implement Table Tags.
3.	Design a Student Registration form using HTML.
4.	Perform the validation of a form using Javascript.
5.	Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference, and quotient.
6.	Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format.
7.	Write a program to the simple calculator using the windows application.
8.	Write a program working with Page using ASP.Net.
9.	Write a program to access data sources through ADO.NET.
10.	Implement Various Types of CSS.
11.	Using JQuery Implement : i. Selecting Element, Getting Values, Setting Values. ii. Events
12.	DOM Manipulation with jQuery. Events in JQuery.
13.	Animation in JQuery.
14.	AJAX with JQuery.
15.	Creating & Integrating Plug-ins with Jquery Using JQuery Frameworks

Suggested Books:

- Ivan Bay Ross, "HTML, DHTML, Javascript, Perl CGI," BPB Publication, 4th Revised Edition, 2010.
- Herbert Schildt, "C# 4.0 The Complete Reference", McGraw-Hill Education, 1st Edition, 2010.
- Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web: How to Program," Pearson, 5th Edition, 2018.
- Jason N. Gaylord, Christian Wenz, Pranav Rastogy, Todd Miranda, Scott Hanselman, "Professional ASP.NET 4.5 in C# and VB", Wrox Publication, 1st Edition, 2013.
- James L Mohler and Jon Duff, "Designing Interactive Web Sites," Delmar Thomson Learning, 1st Edition, 2000.
- John Pollock, "JavaScript: A Beginner's Guide," TMH, 5th Edition, 2020.
- Stephen Walther, Kevin Hoffman, Nate Dudek, "ASP.NET 4.0 Unleashed", Pearson Education, 1st Edition, 2010.
- Jess Chadwick, Todd Snyder, Hrusikesh Panda, "Programming ASP.NET MVC 4", O'Reilly Media, 1st Edition, 2007.

MCA 221: Python Programming

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction and Overview: Introduction** to Python, Origin, Comparison, Comments, Operators, Variables, Classes, Modules Syntax and Style Statements, Variable Assignment, Identifiers, Basic Style Guidelines, Memory Management,	8
2	**Python Objects:** Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types. Numbers and Strings. Introduction to Numbers, Integers, Floating-Point Real Numbers, Complex Numbers, Operators, Built-in Functions. Sequences: Strings, Lists, and Tuples, Sequences, Strings, Strings and Operators, String-only Operators, Built-in Functions, String Built-in Methods, Special Features of Strings	9
3	**Lists and Dictionaries :** Operators, Built-in Functions, List Type Built-in Methods, Special Features of Lists, Tuples, Tuple Operators and Built-in Functions, Special Features of Tuples Introduction to Dictionaries, Operators, Built-in Functions, Built-in Methods, Dictionary Keys, Conditionals and Loops: if Statement, else Statement, while Statement, for Statement, break Statement, continue Statement, pass Statement, else Statement	8
4	**Files, Regular Expression, and Exception Handling:** File Objects, File Built-in Function, File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules. Regular Expression: Introduction/Motivation, Special Symbols, and Characters for REs, REs, and Python. What Are Exceptions? Exceptions in Python, Detecting and Handling Exceptions, Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions	9
5	**Database Interaction:** SQL Database connection using python, creating and searching tables, Reading and storing config information on Database, Programming using database connections, Python Multithreading: Understanding threads, Forking threads, synchronizing the threads, Programming using multithreading	8
	Total	42

Suggested Books:

- Core Python Programming, R. Nageswara Rao, Dreamtech Press, Second Edition, 2018
- Python Programming, Dr. M. Suresh Anand, Dr. R. Jothikumar, Dr. N. Vadivelan, Notion Press, First Edition, 2020
- The Complete Reference Python, Martin C. Brown, McGraw Hill Education, Fourth Edition, 2018
- Think Python, Allen B. Downey, O'Reilly Media, 2016
- Programming and Problem Solving with Python, Amit Ashok Kamthane, Ashok Namdev Kamthane, McGraw Hill HED, First Edition, 2017
- Advanced Python Programming, Sakis Kasampalis, Quan Nguyen, Dr. Gabriele Lanaro, Ingram short title, 2019

MCA 222: Operating Systems

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction to Operating System & Process Management**: Definition and types of operating systems, Operating system components and services, System calls. Process and Thread Management: Process concept, Process scheduling, operations on processes, Threads, Inter-process communication, CPU scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real-time scheduling, and evaluation.	**8**
2	**Memory Management**: Swapping, Contiguous Allocation, Paging, Segmentation with virtual paging Memory, Demand paging, Page replacement algorithms, Allocation of frames, Thrashing, Page Size, and other considerations, Demand segmentation, File systems, secondary Storage Structure, File concept, access methods, directory implementation, Efficiency and performance, Recovery.	**8**
3	**Concurrency Control**: The Critical-Section Problem, Semaphores, Classical problems of synchronization, Critical regions, Monitors, Dining philosopher and producer-consumer problem using semaphores or monitors. Deadlocks-System model, Characterization, Deadlock prevention, Avoidance and Detection, Banker's Algorithm.	**8**
4	**Disk Management:** Disk structure, Disk scheduling methods, Disk management, Recovery, Disk structure, Disk scheduling methods, Disk management, Swap-Space management. Protection and Security-Goals of protection. **UNIX/LINUX Operating System:** Introduction, Features of UNIX/LINUX operating system, Structure: Kernel and Shell, Basic commands, accessing help options, Filenames and using wild cards, Types of files, File systems: four blocks of file systems, directory hierarchy, Operations and utilities for directory and files. User & Group file access permissions.	**8**
5	**Shell Programming**: Introduction to vi and Emacs editor. Basic of shell programming, metacharacters, shell variable: predefined variables and user-defined variable, storing value in a variable and accessing it, unsetting variables, storing filenames, content, and command in a variable, Input: reading word by word, line by line, and from file, Expression, Decisions, and repetition, Special parameters and variables, shell programming in bash, read command, conditional and looping statements, case statements, changing positional parameters and argument validation, string manipulation. **Simple filter commands** – pr, head, tail, cut, paste, sort, uniq, tr, Regular expressions: atoms and operators, grep.	**8**
	Total	**40**

Suggested Books:

- Silberschatz and Galvin, "Operating System Concepts," 10th Edition, Wiley India, 2018.
- Andrew S. Tanenbaum, Albert S. Woodhull, "Operating Systems Design & implementation," 3rd Edition, Pearson Education, 2006.
- Sumitabha Das, "UNIX – Concepts & Applications," Tata McGraw Hill Publications, 4th Edition, 2006.
- Graham Glass & King Ables, "Linux for programmers and users," Pearson Education India, 3rd Edition, 2006.

- William Stallings, "Operating Systems Internals and Design Principles," 5th Edition, Prentice-Hall, 2000.
- Fadi P. Deek, James A. M. McHugh, "Open Source Technology and Policy," Cambridge University Press, 1st Edition, 2008.
- Forouzan B. A., Gilberg R. R., "UNIX and Shell Programming," TMH, 2nd Edition, 2008.

MCA 223: Object-Oriented Programming using Java

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Object-Oriented Programming:** OOP Paradigm, advantages of OOP, characteristics of OOP, features of Java; Token: keyword, identifiers, Literals, Data Types, Operators; The Java Environment: Java Source File, Structure, Compilation, JVM; Structures in Java Program: Defining classes and Object in Java, constructors, methods, access specifiers, static members and method, Comments, Control Flow; Packages, API	8
2	**Exception Handling**: try-catch, finally, throw, throws, wrapper classes, Array, String, vector, Inheritance, final class and method, abstract class and method, interface, method overloading and method overriding, **Files and I/O Streams:** An Overview of I/O streams – Java I/O – File streams – File Input stream and File output stream – Filter streams –Random Access File – Serialization.	8
3	**Swings:** swing Classes, Working with Frame Window, Graphics, Color, Adding Controls: Labels, TextField, TextArea, Buttons, Checkbox, RadioButton, Lists, ComboBox, Dialog Box, Menus, Event Handling; **JDBC:** JDBC APIs and methods, JDBC Drivers, Connectivity to Database;	8
4	**Introduction to J2EE:** Servlets fundamentals, the life cycle of servlet, servlets and HTML, servlet configuration, retrieving data in servlet, servicing the GET and POST requests, session tracking **Struts Framework:** Introduction of Struts and its architecture, advantages, and application of Struts.	8
5	**JSP:** JSP Fundamentals, architecture, JSP directives, implicit objects, standard actions, JSP errors, different packages of JSP and servlet,**Spring Framework:** Introduction of Spring Framework: Configuration of Spring environment, Spring Architecture,	8
	Total	40

Suggested Books:

- John Hunt and Chris Loftus, "Guide to J2EE: Enterprise Java", Springer Verlag Publications, 1st Edition, 2003.
- Govind Sesadri, "Enterprise Java Computing: Application and Architectures," Cambridge University Publications, 2nd Edition, 1999.
- Jeff Linwood and Dave Minter, "Beginning Hibernate," Apress Publishing Co., 2nd Edition, 2010.
- Rod Johnson, "Professional Java Development with the Spring Framework," John Wiley & Sons, 2nd Edition, 2005.
- The Complete reference Java Ninth Edition By Herbert Schildt (Tata McGraw Hill)
- Programming in Java By E. Balagurusamy (TMH)
- Ted Neward, "Effective Enterprise Java," Pearson Education, 2nd Edition, 2004.
- Jim Farley and William Crawford, "Java Enterprise in a Nutshell," O'Reilly and Associates, 3rd Edition, 2005.

MCA 224 : Full Stack Development

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction to React:** Definition of React, Obstacles, and Roadblocks, React library, React Developer tools, Introduction to ES6, Declaring variables in ES6, Arrow Functions, ES6 Objects and Arrays, ES6 modules, **Pure React:** Page setup, virtual DOM, React Element, React DOM, Constructing Elements with Data, React Components, DOM Rendering, First React Application using Create React App, React with JSX, React Element as JSX. Props, State and Component Tree: Property Validation, Validating Props with create Class, Default Props, ES6 Classes, and stateless functional components React state management, State within the component tree, state vs. props, Forms in React.	9
2	**Enhancing Components:** Component Lifecycle, JavaScript library integration, Higher-Order Components, Managing state outside the react, Introduction to Flux Redux and Router: State, Actions, Reducers, The Store, Middleware, React-Redux, React Router, Incorporating the router, Nesting Router, Router parameters **JSON:** Introduction, Syntax, Data types, Objects, Schema REST API: Introduction, WRML, REST API Design, Identifier Design with URIs, Interaction Design with HTTP, Representation Design, Caching, Securit	9
3	**Introduction to Angular:** Angular architecture; introduction to components, component interaction and styles; templates, interpolation, and directives; forms, user input, form validations; data binding and pipes; retrieving data using HTTP; Angular modules Node.js: Introduction, Features, Node.js Process Model Environment Setup: Local Environment Setup, The Node.js Runtime, Installation of Node.js Node.js Modules: Functions, Buffer, Module, Module Types	8
4	**Node Package Manager:** Installing Modules using NPM, Global vs. Local Installation, Attributes of Package.js on, updating packages, Mobile-first paradigm, Using Twitter bootstrap on the notes application, Flexbox, and CSS Grids File System: Synchronous vs. Asynchronous, File operations Web Module: Creating Web Server, Web Application Architecture, Sending Requests, Handling HTTP requests Express Framework: Overview, Installing Express, Request / Response Method, Cookies Management	8
5	**MongoDB:** Introduction to NoSQL, Understanding MongoDB data types, Building MongoDB Environment (premise and cloud-based), Administering Databases and User accounts, Configuring Access Control, Managing Collections, connecting to MongoDB from Node.js, Accessing and Manipulating Databases and Collections, Manipulating MongoDB documents from Node.js, Understanding Query objects, sorting and limiting result sets	8
	Total	42

Suggested Books:

- D. Brad, B. Dayley, and C. Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications," Addison-Wesley Professional, 2nd Edition, 2017.
- D. Herron, "Node.js Web Development," Packt Publishing, 2nd Edition, 2018.
- A. Banks and E. Porcello, "Learning React: Functional Web Development with React and Redux," O'Reilly, 1st Edition, 2017.

- M. Masse, "REST API – Design Rulebook," O'Reilly, 1st Edition, 2011.
- S. Pasquali and K. Faaborg, "Mastering Node.js," Packt Publishing Limited, 2nd Edition, 2017.
- RB2. T. Dyl and K. Przeorski, "Mastering Full-Stack React Web Development," Packt Publishing Limited, 1st Edition, 2017.
- C.J. Ihrig and A Bretz, "Full Stack JavaScript Development with MEAN," SitePoint, 1st Edition, 2015.
- E.W.I. Koroliova, "MERN Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node," Packt Publishing Limited, 1st Edition, 2018.

MCA 225: Cloud Computing

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction to Cloud:** Cloud Computing at a Glance, Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments, Risks and Approaches of Migration into Cloud, Types of Clouds, Services models, Cloud Reference Model.	8
2	**Cloud Architecture:** cloud architecture, features, and benefits of Service Models: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.	8
3	**Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, **Technology Examples-** VMware and Microsoft Hyper-V. Virtualization of CPU, Memory, I/O Devices, Virtual Cluster, data center, and Resources Management.	8
4	**Securing the Cloud:** Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture. Legal issues in Cloud Computing. **Data Security in Cloud:** Risk Mitigation, Understanding, and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management	8
5	**Defining the Clouds for Enterprise:** Storage as a service, Database as a service, Process as a service, Information as a service, Integration as a service, and Testing as a service. Disaster Management in Cloud: Disasters in the Cloud, Disaster Recovery Planning.	8
	Total	40

Suggested Books:

- San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing," Wiley, 2016
- Kai Hawang, Geoffrey. Fox, Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things," Morgan Kaufmann, 2013
- RajkumarBuyya, JemesBroberg, A. Goscinski, "Cloud Computing: Principal and Paradigms," Wiley, 2011
- Krutz, Vines, "Cloud Security, "Wiley Pub, 2014
- Velte, "Cloud Computing- A Practical Approach," TMH Pub, 2015

MCA 226 : Cyber Security and Digital Forensics

Credit: 3	Max Marks: 100 (IA :20, ETE:80)
3L+0T+0P	End Term Exams: 3hr

S.No.	Contents	Hours
1	**Introduction to Cyber Security :** Cybercrime and origins of the world, Cybercrime and information security, Classifications of Cybercrime, Cybercrime and the Indian ITA- 2000, A global Perspective on cybercrimes Cyber offenses & Cybercrimes- How criminals plan the attacks, Industrial Spying/Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Email Spoofing, Spamming, data diddling, salami attack, Cyber defamation, Internet Time Theft, Social Engg, Cyberstalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era.	8
2	**Tools and Methods Used in Cybercrime**: Phishing, Password Cracking, Keyloggers and Spywares, Virus, worms and trojans, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft)	8
3	**Introduction to Digital Forensics** - Introduction to Digital Forensics and its uses. Need of Digital Forensics, Digital forensic life cycle, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing and Anti-forensics.	8
4	**Data Recovery and Evidence Collection Data Recovery**: Defined data backup and Recovery, the role of backup in data recovery, Data recovery solutions, Hiding and recovering Hidden data Evidence Collection and Data Seizure: What is digital evidence, rules of evidence, Characteristics of evidence, Types of evidence, Volatile evidence, General procedure for collecting evidence, Methods of collection and collection steps, Collecting and archiving, Evidence handling procedures, Challenges in Evidence handling Duplication and Preservation of Digital Evidence.	9
5	**Network Forensic and Steganography Network Forensics:** Network Fundamentals, Network Types, Network security tools, and attacks, Intrusion Detection Systems (types and advantages and disadvantages) Email Investigations – Email protocol, Email as Evidence, Working of E Mail, Steps in the Email communication, IP Tracking, Email Recovery, Android Forensic-Android forensic- The evolution of Android, The Android model, Android security, The Android file hierarchy, The Android file system, Android Data Extraction Techniques: Manual data extraction, Logical data extraction, Physical data extraction Cyber Forensics Tools: Tool Selection, hardware, Software, Tools (FKT, PKT) Steganography – categories of steganography in Forensics (Text, Image, Audio)	9
	Total	42

Suggested Books: • Nina Godbole, SunitBelapurCyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives –, Wiley India Publications Released: April 2011 • John Sammons, "The Basics of Digital Forensics," Elsevier 2012 • Computer Forensics, Computer Crime Scene Investigation. By John R. Vacca, Charles River Media, INC. 2nd Edition • Jain, Dr. Dhananjay R. Kalbande, Digital Forensic The Fascinating world of Digital forensic • Anthony Reyes, The Best Damn Cybercrime and Digital Forensics Book Period, Jack Wiles • Practical Mobile Forensics: SatishBommisetty, RohitTamma, and Heather Mahalik, Pack Publishing LTD 2014, ISBN-978- -1-78328-831-1 • Investigating Network Intrusions and Cybercrime EC-Council | Press • Computer Forensic investing Network Intrusions and Cybercrime by Course Technology	

MCAL 227 : Python Programming Lab

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No.	List of Experiments
1	Installation of Python and learning interactively at the command prompt and writing simple programs.
2	Write a program to compute the distance between two points taking Input from the user (Pythagorean Theorem).
3	Write a Program for checking whether the given number is an even number or not.
4	Write a Python class to implement pow(x, n)
5	Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure
6	Write a program to print each line of a file in reverse order.
7	Write a program to compute the number of characters, words, and lines in a file.
8	Write a program for Finding unique and duplicate items of a list.
9	Write a program to demonstrate working with tuples in python.
10	Write a program to count the numbers of characters in the string and store them in a dictionary data structure
11.	Write a python program to define a module and import a specific function in that module to another program.
12.	Write a script named filecopy.py. This script should prompt the user for the names of two text files. The contents of the first file should be Input and written to the second file.

Suggested Books:

- Budd T A, "Exploring Python," McGraw-Hill Education, 1st Edition, 2011.
- Mark Lutz, "Learning Python," O'Reilly, 4th Edition, 2013.
- Y. Daniel Liang, "Introduction to Programming Using Python," Pearson, 1st Edition, 2013
- Kenneth A. Lambert, "The Fundamentals of Python: First Programs," Cengage Learning, 1st Edition, 2011.
- Reema Thareja, "Python Programming using Problem Solving Approach," Oxford University Press, 1st Edition, 2017.
- Joel Grus, "Data Science from Scratch," O'Reilly, 2nd Edition, 2019.
- Tony Gaddis, "Starting out with Python," Pearson, 3rd Edition, 2014.

MCAL 228: Object-Oriented Programming Lab Using Java

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No	List of Experiments
1	Write a java program that prints all real solutions to the quadratic equation ax2 +bx+c=0. Read in a, b, c and use the quadratic formula.
2	The following rule defines the Fibonacci sequence. The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a java program that uses both recursive and non-recursive functions
3	Write a java program to multiply two given matrices.
4	Write a java program to implement a) Method overloading and constructors overloading b) Write a java program to implement method overriding.
5	Write a java program to check whether a given string is a palindrome.
6	Write a java program for sorting a given list of names in ascending order
7	Write a java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given Shape
8	Write a program that creates a user interface to perform integer division. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 and Num2 were not integers, the program would throw a Number Format Exception. If Num2 were zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box
9	Write a java program that implements a multi-thread application that has three threads. First thread generates a random integer every 1 second, and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
10	a) Write a java program that displays the number of characters, lines, and words in a text file. b) Write a java program that reads a file and displays the file on the screen with a line number before each line.
11	Write a java program that loads names and phone numbers from a text file where the data is organized as one line per record, and each field in a record is separated by a tab (/t). It takes a name or phone number as input and prints the corresponding other value from the hash table. Hint: Use hash tables
12	Write a java program that connects to a database using JDBC and does add, delete, modify and retrieve operations.

Suggested Books:

- John Hunt and Chris Loftus, "Guide to J2EE: Enterprise Java", Springer Verlag Publications, 1st Edition, 2003.

- Govind Sesadri, “Enterprise Java Computing: Application and Architectures,” Cambridge University Publications, 2nd Edition, 1999.
- Jeff Linwood and Dave Minter, “Beginning Hibernate,” Apress Publishing Co., 2nd Edition, 2010.
- Rod Johnson, “Professional Java Development with the Spring Framework,” John Wiley & Sons, 2nd Edition, 2005.
- The Complete reference Java Ninth Edition By Herbert Schildt (Tata McGraw Hill)
- Programming in Java By E. Balagurusamy (TMH)
- Ted Neward, “Effective Enterprise Java,” Pearson Education, 2nd Edition, 2004.
- Jim Farley and William Crawford, “Java Enterprise in a Nutshell,” O’Reilly and Associates, 3rd Edition, 2005.
- James Holmes and Herbert Schildt, “The Complete Reference- Struts,” Tata McGraw Hill, 2nd Edition, 2007.

MCAL 229 : Full Stack Development Lab

Credit: 2	Max Marks: 100 (IA :60, ETE:40)
0L+0T+4P	End Term Exams: 3hr

S.No	List of Experiments
1.	Design front-end application using basic React.
2.	Design front-end applications using functional components of React.
3.	Design back-end applications using Node.js.
4.	Construct web-based Node.js applications
5.	Implement the concepts of Buffers, Streams, and Events
6.	Implement Multi-Processing in NodeJS
7.	Integrate Angular application with other Javascript libraries such as Node.js
8.	Use MongoDB to store data in Database

Suggested Books:

- D. Brad, B. Dayley, and C. Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications," Addison-Wesley Professional, 2nd Edition, 2017.
- D. Herron, "Node.js Web Development," Packt Publishing, 2nd Edition, 2018.
- Banks and E. Porcello, "Learning React: Functional Web Development with React and Redux," O'Reilly, 1st Edition, 2017.
- M. Masse, "REST API – Design Rulebook," O'Reilly, 1st Edition, 2011.
- S. Pasquali and K. Faaborg, "Mastering Node.js," Packt Publishing Limited, 2nd Edition, 2017.
- T. Dyl and K. Przeorski, "Mastering Full-Stack React Web Development," Packt Publishing Limited, 1st Edition, 2017.
- C.J. Ihrig and A Bretz, "Full Stack JavaScript Development with MEAN," SitePoint, 1st Edition, 2015.
- E.W.I. Koroliova, "MERN Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node," Packt Publishing Limited, 1st Edition, 2018.Jim Farley and William Crawford, "Java Enterprise in a Nutshell," O'Reilly and Associates, 3rd Edition, 2005.
- James Holmes and Herbert Schildt, "The Complete Reference- Struts," Tata McGraw Hill, 2nd Edition, 2007.