DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS
SCHEME AND SYLLABUS OF EXAMINATION FOR
MASTER OF COMPUTER APPLICATIONS (MCA)
Duration 2 Years (4 Semesters)
w.e.f. 2020-21 (CBCS)

	Semester – I					
Paper Code	**Title of the Paper**	**Credit**	**L : T : P**	**Maximum Marks**		**Total**
				External	**Internal**	
	Foundation Courses					
MCA-20-101	Advanced Software Engineering	5	4 : 1 : 0	80	20	100
	Core Courses					
MCA-20-102	Object Oriented Modeling and Design using UML	3	3 : 0 : 0	48	12	60
MCA-20-103	Software Lab – I (Based on MCA-20-102)	2	0: 0 : 4	32	08	40
MCA-20-104	Data Base Management System	3	3 : 0 : 0	48	12	60
MCA-20-105	Software Lab – II (Based on MCA-20-104)	2	0: 0 : 4	32	08	40
	Core Elective (Bouquet-I)					
MCA-20-111	Web Technologies (HTML,DHTML,CSS)	2	2 : 0 : 0	32	08	40
MCA-20-112	Software Lab – III (Based on MCA-20-111)	3	0: 0 : 6	48	12	60
MCA-20-113	Java Script	2	2 : 0 : 0	32	08	40
MCA-20-114	Software Lab – IV (Based on MCA-20-113)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet-II)					
MCA-20-121	Programming with Python	2	2 : 0 : 0	32	08	40
MCA-20-122	Software Lab – V (Based on MCA-20-121)	3	0: 0 : 6	48	12	60
MCA-20-123	Programming with R	2	2 : 0 : 0	32	08	40
MCA-20-124	Software Lab – VI (Based on MCA-20-123)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet-III)					
MCA-20-131	Computer System Architecture	5	4 : 1 : 0	80	20	100
MCA-20-132	Discrete Mathematics	5	4 : 1 : 0	80	20	100
	Total	**25**				**500**

Paper Code	Title of the Paper	Credit	L : T : P	Maximum Marks		Total
				External	Internal	
	Semester – II					
	Foundation Courses					
MCA-20-201	Data and File Structures	3	3 : 0 : 0	48	12	60
MCA-20-202	Software Lab – VII (Based on MCA-20-201)	2	0: 0 : 4	32	08	40
	Core Courses					
MCA-20-203	Programming with Java	2	2 : 0 : 0	32	08	40
MCA-20-204	Software Lab – VIII (Based on MCA-20-203)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet-I)					
MCA-20-211	PHP	2	2 : 0 : 0	32	08	40
MCA-20-212	Software Lab – IX (Based on MCA-20-211)	3	0: 0 : 6	48	12	60
MCA-20-213	XML	2	2 : 0 : 0	32	08	40
MCA-20-214	Software Lab – X (Based on MCA-20-213)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet-II)					
MCA-20-221	Data Warehousing and Mining	3	3 : 0 : 0	48	12	60
MCA-20-222	Software Lab – XI (Based on MCA-20-221)	2	0: 0 : 4	32	08	40
MCA-20-223	Python Libraries and R Packages	2	2 : 0 : 0	32	08	40
MCA-20-224	Software Lab – XII (Based on MCA-20-223)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet-III)					
MCA-20-231	Research Methods in Computer Science	5	4 : 1 : 0	80	20	100
MCA-20-232	Theory of Computation	5	4 : 1 : 0	80	20	100
	Open Elective Course					
To be assigned by Examination Branch	Computer Fundamentals	5	4 : 1 : 0	80	20	100
	Total	**25**				**500**

	Semester – III					
Paper Code	**Title of the Paper**	**Credit**	**L : T : P**	**Maximum Marks**		**Total**
				External	**Internal**	
	Foundation Courses					
MCA-20-301	Artificial Intelligence	3	3 : 0 : 0	48	12	60
MCA-20-302	Software Lab – XIII (Based on MCA-20-301)	2	0: 0 : 4	32	08	40
	Core Courses					
MCA-20-303	Operating System with Linux	3	3 : 0 : 0	48	12	60
MCA-20-304	Software Lab – XIV (Based on MCA-20-303)	2	0: 0 : 4	32	08	40
	Core Elective (Bouquet-I)					
MCA-20-311	Dot Net Framework and C#	2	2 : 0 : 0	32	08	40
MCA-20-312	Software Lab – XV (Based on MCA-20-311)	3	0: 0 : 6	48	12	60
MCA-20-313	Dissertation / Project Work	10	0 : 0 :20	160 (80 Evaluation + 80 Viva Voce)	40	200
	Core Elective (Bouquet-II)					
MCA-20-321	Cloud Computing	3	3 : 0 : 0	48	12	60
MCA-20-322	Software Lab – XVI (Based on MCA-20-321)	2	0: 0 : 4	32	08	40
MCA-20-323	Dissertation / Project Work	10	0 : 0 :20	160 (80 Evaluation + 80 Viva Voce)	40	200
	Core Elective (Bouquet-III)					
MCA-20-331	Design and Analysis of Algorithms	5	4 : 1 : 0	80	20	100
MCA-20-332	Dissertation / Project Work	10	0 : 0 :20	160 (80 Evaluation + 80 Viva Voce)	40	200
	Open Elective Course					
To be assigned by Examination Branch	Office Automation Tools	5	4 : 1 : 0	80	20	100
	Total	**30**				**600**

Paper Code	Semester – IV Title of the Paper	Credit	L : T : P	Maximum Marks		Total
				External	Internal	
	Foundation Courses					
MCA-20-401	Mobile Applications Development	2	2 : 0 : 0	32	08	40
MCA-20-402	Software Lab – XVII (Based on MCA-20-401)	3	0: 0 : 6	48	12	60
	Core Courses					
MCA-20-403	Soft Computing	2	2 : 0 : 0	32	08	40
MCA-20-404	Software Lab – XVIII (Based on MCA-20-403)	3	0: 0 : 6	48	12	60
MCA-20-405	Data Communication and Networking	3	3 : 0 : 0	48	12	60
MCA-20-406	Software Lab – XIX (Based on MCA-20-405)	2	0: 0 : 4	32	08	40
	Core Elective (Bouquet I)					
MCA-20-411	Angular JS and Node JS	2	2 : 0 : 0	32	08	40
MCA-20-412	Software Lab – XX (Based on MCA-20-411)	3	0: 0 : 6	48	12	60
MCA-20-413	React JS and Django	2	2 : 0 : 0	32	08	40
MCA-20-414	Software Lab – XXI (Based on MCA-20-413)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet II)					
MCA-20-421	Big Data Analytics	3	3 : 0 : 0	48	12	60
MCA-20-422	Software Lab – XXII (Based on MCA-20-421)	2	0: 0 : 4	32	08	40
MCA-20-423	Programming with Julia	2	2 : 0 : 0	32	08	40
MCA-20-424	Software Lab – XXIII (Based on MCA-20-423)	3	0: 0 : 6	48	12	60
	Core Elective (Bouquet III)					
MCA-20-431	Compiler Design	5	4 : 1 : 0	80	20	100
MCA-20-432	Computer Graphics and Multimedia	3	3 : 0 : 0	48	12	60
MCA-20-433	Software Lab – XXIV (Based on MCA-20-432)	2	0: 0 : 4	32	08	40
	Total	**25**				**500**

Note :

1. Internal Marks in each paper will be awarded by the concerned teacher on the basis of MCA Ordinance w.e.f. Academic Session 2020-21.
2. Size of Groups for all practical and viva-voce examinations should not be more than twenty five.

MCA-20-101 Advanced Software Engineering

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To understand Software Process Models.*
2. *To understand Software Requirements and Software Designs*
3. *To Understand Basic Software Quality and Assurance concepts.*
4. *To Estimate the Project Size and Complexity.*
5. *To Understand different types of Software Testing.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Software Process Models: Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods, Agile Process Models – Extreme Programming (XP), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

UNIT-II

Software Requirements: Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modeling; Requirements Review, Software Requirment and Specification (SRS) Document.
Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design

UNIT-III

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Tesing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.

Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering

UNIT-IV

Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability

Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

Suggested Readings

1. Pressman R. S., "*Software Engineering – A practitioner's approach"*, 7th Ed., Tata McGraw Hill, 2009.
2. Sommerville, *"Software Engineering"*, 9thEd., Pearson Education, 2010.
3. Pfleeger, *"Software Engineering: Theory and Practice"*, 4th Ed., Pearson Education, 2009.
4. P. Jalote, "*An Integrated approach to Software Engineering*", 2nd Ed., Narosa Publications,1997.
5. James Peter, W. Pedrycz, *"Software Engineering*", Wiley India Pvt. Ltd, 2007.

MCA-20-102 Object Oriented Modeling and Design using UML

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of modeling and its components.*
2. *To provide the detail of state model and it's working.*
3. *To understand the steps followed for system design.*
4. *To understand various interaction models with reference to UML design.*
5. *To understand application of modeling with case study.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: Object-Orientation, Object Oriented Methodology, Modeling,
Class Modeling: Object, Class, Value & Attributes, Operation & Method, Link & Association, Association Classes, Qualified association, Multiplicity, Association end name, Ordering, Bag &Sequences, Generalization & Inheritance, Uses of Generalization.

UNIT-II

Advance Class Modeling: Advanced Object & Class Concepts, N-Array association, Aggregation, Abstract Class, Multiple Inheritance, Metadata.
State Modeling: Events, States, Transition & Conditions, State Diagram, State Diagram Behavior.
Advanced State Modeling: Nested State Diagram, Nested States, Signal Generalization, Concurrency.

UNIT-III

System Design: Overview, Estimating Performance, Making a reuse plan, Breaking a system into subsystems, Identifying Concurrency, Allocation of subsystem, Management of data storage, Handling global resources, Choosing a software control strategy, Handling boundary conditions, Setting trade-off priorities.

UNIT-IV

Interaction Modeling:
Use Case Models: Actors, Use case, Use case diagram, Guidelines for use case diagram.
Sequence Model: Scenarios, Sequence Diagrams, Guidelines for Sequence model.
Activity Model: Activities, Branches, Initiation & Termination, Concurrent Activities, Executable Activity Diagram, Guidelines for Activity diagram.
Case Study: Working of ATM with reference to implementation of basic structure, advanced structure, and functionality.

Suggested Readings:

1. Michael Blaha, James Rumbaugh, *"Object Oriented Modeling and Design with UML"*, Pearson Education, 2011.
2. Michael R Blaha, James R Rumbaugh, *"Object Oriented Modeling and Design with UML, UML2*", Pearson, 2007.
3. Daminni Grover, *"Object Oriented Analysis and Design with UML"*, I. K International Publishing House, 1st edition, 2012.
4. Martin Fowler, *"UML Distilled"*, Pearson Education Inc., 2018.
5. Mike O'Docherty, "*Object Oriented Analysis And Design Understanding System Development with UML 2.0",* Wiley Dreamtech, 2005.

MCA-20-103 Software Laboratory - I

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of modeling and its components.*
2. *To provide the detail of state model and it's working.*
3. *To understand the steps followed for system design.*
4. *To understand various interaction models with reference to UML design.*
5. *To understand application of modeling with case study.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-102.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-104 Database Management System

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of database and database management system.*
2. *To provide the detail of various data models.*
3. *To understand the relational calculus.*
4. *To understand the effects of transaction processing methods.*
5. *To gain knowledge about the latest industrial applications of database.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Database System: Definition, Characteristics, Relational data models, Schemas, Instances, Three schema architecture and data independence.
Data modeling : Entity, Entity type, Entity set, Attributes, Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak entity type, Naming convention for ER diagram, Design issues, Subclass, Super class, Inheritance, Specialization & Generalization.

UNIT-II

Relational Algebra: Select, Project, Join, Division, Union, Intersection, Minus, Cartesian product.
Relational Calculus: Tuple variable, Range relations, Expressions, Formulas, Existential & Universal Quantifiers & there transformation, Using the Universal Quantifier, Safe expression, Domain relational calculus.

UNIT-III

Transaction Processing: Introduction, Single User, Multiuser, Read and Write Operation, Lost update problem, Temporary update, Incorrect summary problem, Traction states, System log, Commit point of a transaction, Desirable properties, Serial, Non serial & Conflict Serializable schedule, Testing of Conflict Serializability of a schedule, View equivalence & View serializability.

UNIT-IV

Emerging Database Technologies and Applications: Geographical Information System: Components of GIS Systems, Characteristics of Data in GIS, Conceptual Data Models for GIS, GIS standards and Operations, GIS Applications and Future Works.
Genome Data Management: Characteristics of Biological Data, The Human Genome projects and existing biological database.

Suggested Readings:

1. Ramez Elmasri, Shamkant B. Navathe, *"Fundamentals of Database Systems"*, Pearson, 6th edition, 2010.
2. Silberschatz Abraham , *"Database System Concept"*, Tata Mc Graw Hill, 7th edition, 2019.
3. C. J Date , *"Introduction to Database Systems*", Pearson Education, 8th edition, 2004.
4. Krishnan Ram and Gehrke , *"Database Management System",* , Tata Mc Graw Hill, 2003.
5. Byross Ivan , *"Oracle 10 G The Database with HTML Database*", BPB publication,2006.

MCA-20-105 Software Laboratory - II

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of modeling and its components.*
2. *To provide the detail of state model and it's working.*
3. *To understand the steps followed for system design.*
4. *To understand various interaction models with reference to UML design.*
5. *To understand application of modeling with case study.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-104.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-111 Web Technologies (HTML, DHTML, CSS)

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of Web Engineering.*
2. *To have hands-on experience on HTML.*
3. *To have hands-on experience on CSS.*
4. *To have hands-on experience on DHTML.*
5. *To create a web application with HTML, CSS and DHTML.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Web essentials: Brief History of Internet , World Wide Web, URL Client Server Architecture, internet protocols, WWW, Web Browser and its functions, URL, Web Servers and its functions. E-Mail Concepts - configuring E-Mail Program, Sending and Receiving Files through EMail, Fighting Spam, Sorting Mail, and Avoiding E-Mail Viruses.
Basics of web Designing: Basic principles involved in developing a web site, Web site design principles, planning the site and navigation.

UNIT-II

Introduction to HTML : What is HTML , HTML Documents , Basic structure of an HTML document , Creating an HTML document ,Mark up Tags ,Heading-Paragraphs , Line Breaks ,HTML Tag
Elements of HTML:Introduction to elements of HTML , Working with Text , Working with Lists, Tables and Frames ,Working with Hyperlinks, Adding Images, Working with Forms and controls, Embedded Media: .

UNIT-III

Cascading Style Sheets: Features, Core Syntax, Types, Style Sheets and HTML, StyleRules - Cascading and Inheritance, Text Properties, CSS Box Model, Floating and Positioning, CSS Layout with Flexbox and Grid, Responsive Web Design, Transitions, Transforms and Animations.

UNIT-IV

Dynamic HTML: Introduction of DHTML- difference between HTML, XHTML and DHTML, Advantages of DHTML, CSS of DHTML, Event Handling, Data Binding, Browser Object Models.

Suggested Readings:

1. Jennifer Robbins, "*Learning Web Design, A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*", O'Reilly media, 5th edition, 2018.
2. Don Gosselin , "*Principles of HTML, XHTML, and DHTML: The Web Technologies Series*", Cengage publications, 1st Edition, 2011.
3. Jennifer Robbins, "*Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript*, *and Web Graphics*", O'Reilly Media, 5th edition, 2018.

MCA-20-112 Software Laboratory - III

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of Web Engineering.*
2. *To have hands-on experience on HTML.*
3. *To have hands-on experience on CSS.*
4. *To have hands-on experience on DHTML.*
5. *To create a web application with HTML, CSS and DHTML.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-111.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-113 Java Script

Maximum marks: 40
Time: 2 hours

External: 32
Internal: 08
Credit: 2

Course Objectives:

1. *To understand Client side scripting using Java Script.*
2. *To provide an overview of Data Types and operators in Java Script.*
3. *To understand Function, flow control and dialog boxes.*
4. *To know how to deal with Regular expressions.*
5. *To provide the concept of Form handling and State management using JavaScript.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction and overview of Java Script: Common uses of JavaScript, Overview of JavaScript Core Language Features, input and output in JavaScript.
Data Types and variables: Numbers, Strings, Booleans, Null, Objects, Arrays, type conversion, identifiers, variable declaration, implicit variable declaration, variable scope, constants.
JavaScript Operators: assignment, arithmetic, bitwise, increment/decrement, comparison, logical, ? and comma operator, typeof, Object operators, operator precedence and associativity.

UNIT–II

JavaScript Flow Control statements: if statements, switch, for loops, while loops, do-while loops, break, continue, label, return.
JavaScript Functions: Parameter passing basics, return statements, parameter passing: In and Out, Global and Local variable scope, recursive functions.
Dialog boxes: Alert dialog box, prompt dialog box, confirm dialog box

UNIT-III

Objects in JavaScript: Object creation, object destruction and garbage collection, common properties and methods, Array object, Date object, Math object, Number object, Boolean object and String object.
Regular Expressions: The need for Regular expressions, Creating Patterns, RegExp object, test( ), compile(), exec( ), RegExp Properties, String methods for Regular expressions: search(), split(), replace() , match( )

JavaScript Object Models:Object Model overview, The initial JavaScript Object Model, Accessing Document Elements by Position and by Name, Event handling, DOM Event Model. Window object.

UNIT- IV

Form Handling: The need for Form checking, Accessing Forms and Fields, Form Fields: Common input element properties, Text fields, Text Area, Buttons, Checkboxes and Radio Buttons, Select Menus, Hidden Fields, Form Validation.
State Management: Using Cookies in JavaScript for User state management, storing cookies, reading cookies, setting cookie expiry date, deleting a cookie, Cookie Limitations

Suggested Readings:

1. David Flanagan, "*JavaScript: The Definitive Guide: Activate Your Web Pages"*, O' Reilly, 6th edition, 2011.
2. Thomas Powell, "*JavaScript: the Complete Reference"*, McGraw Hill, 3rd edition, 2012.
3. Douglas Crockford, "*JavaScript: The Good Parts*", O' Reilly, 1st edition, 2008.
4. Deitel, Deitel, Goldberg, "*Internet & World Wide Web How To Program*", 4th Edition, Pearson Education, 2009.
5. Robert. W. Sebesta, "*Programming the World Wide Web*", 4th Edition, Pearson Education, 2011.

MCA-20-114 Software Laboratory - IV

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand Client side scripting using Java Script.*
2. *To provide an overview of Data Types and operators in Java Script.*
3. *To understand Function, flow control and dialog boxes.*
4. *To know how to deal with Regular expressions.*
5. *To provide the concept of Form handling and State management using JavaScript..*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-113.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	1**5**

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-121 Programming with Python

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of Python programming.*
2. *To provide the detail of various components of Python.*
3. *To understand the strings and lists in Python.*
4. *To understand working of dictionaries and tuples.*
5. *To understand files in Python.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Overview of Python, Comments, Reserve Keywords, Identifiers, Variables, Constants, Standard Data types, Operators, Control Statements, Iterative Statements..
Functions: Built in functions, Composition of functions, User defined Functions, Parameters, Function call, Return statement, Recursive function.

UNIT-II

Strings: Compound Data Type, Len function, Slices, Traversal, Escape Character, Formatting Operator, Formatting Functions.
Lists: Values & Accessing Elements, Traversal, Deleting Element, Built-in Operators, Built-in Methods.

UNIT-III

Tuples: Creating, Accessing Values in Tuples, Tuples Assignment, Tuples as Return Values, Variable length Argument Tuple, Basic Operations, Built-in- Tuple Function.
Dictionaries: Creating, Accessing Values, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary Keys, Operations in Dictionary, Built-in Dictionary Methods

UNIT-IV

Text Files and Exceptions: Text Files, Dictionaries, Exceptions, Exception with arguments, User defined exceptions.
Applications in Python: Managing Database using SQL: Database concept, Creating database & tables, Inserting data into tables, Retrieving data from table, Deleting data from table & deleting table.

Suggested Readings:

1. E. Balagurusamy , "*Introduction to Computing and Problem Solving Using Python",* McGrawHill Education, 2017.
2. Sheetal Taneja, Naveen Kumar, *"Python Programming A Modular Approach*", Pearson, 2017.
3. Rao R. Nageswara , *"Core Python Programming*", Dream Tech, New Delhi, 2018.
4. Satyanarayana, Mani M. Radhika, Jagadesh B.N , *"Python Programming*", India University Press, 2018.
5. Cassell Laura, Gauld Alan , *"Python Projects"*, , Wiley Publication, New Delhi, 2014.

MCA-20-122 Software Laboratory - V

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of Python programming.*
2. *To provide the detail of various components of Python.*
3. *To understand the strings and lists in Python.*
4. *To understand working of dictionaries and tuples.*
5. *To understand files in Python.*

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Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-121.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	1**5**

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-123 Programming with R

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of R programming.*
2. *To provide the detail of statistical functions and data handling.*
3. *To understand the control structures and loops in R.*
4. *To understand various regression techniques and validation.*
5. *To provide the details of Clustering techniques and Model fitting.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction to R Studio, Variables, Data Types, Vectors, Calling Functions, Function Documentation, Missing Data, Pipes, Frames, Lists, Matrices, Arrays.
Reading CSVs, Reading Excel Data, Reading from Databases, Reading Data from other Statistical Tools, Reading R Binary Files, Reading Data included with R, Extracting Data from Websites. Statistical Graphics using R, Writing R functions.

UNIT-II

Control Statements : if and else, switch, ifelse, compound tests.
Loops : for loop, while loop, controlling loop, Group Manipulations, Iterating, Data Reshaping, Data Reshaping, Manipulating Strings.

UNIT-III

Basic Statistics, Probability Distribution, Simple Linear Regression, Multiple Regression, Logistic Regression, Poisson Regression, Survival Analysis.
Residuals, Comparing Models, Cross Validation, Bootstrap, Stepwise Variable Selection.
Elastic Net, Bayesian Shrinkage.

UNIT-IV

Non Linear Least Squares, Splines, Generalized Additive Models, Decision Trees, Boosted Trees, Random Forests. Autoregressive Moving Average, VAR, GARCH.
Clustering : K Means, PAM, Hierarchical Clustering.

Model Fitting. Reproducibility and Reports with LaTeX, Rich Documents with R Markdown.

Suggested Readings:

1. Jared P. Lander, "*R for Everyone: Advanced Analytics and Graphics"*, Pearson Education, 2018.
2. Michael J. Crawley, "*The R Book"*, John Wiley & Sons, 2007.
3. Brian S. Everitt, Toresten Hothorn,"*A Handbook of Statistical Analyses using R*", CRC Press, 2006.

MCA-20-124 Software Laboratory - VI

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of R programming.*
2. *To provide the detail of statistical functions and data handling.*
3. *To understand the control structures and loops in R.*
4. *To understand various regression techniques and validation.*
5. *To provide the details of Clustering techniques and Model fitting.*

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Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-123.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-131 Computer System Architecture

Maximum marks: 100
Time: 3 hours

External: 80
Internal: 20
Credit: 5

Course Objectives:

1. *To understand the basic principles on how computers works, how they are designed and their different architectures?*
2. *To understand the digital logic circuits and components.*
3. *To understand the different type of instructions and their formats used by the computer to perform operations.*
4. *To understand the in depth architecture and organization of a modern computer with its various processing units (control units).*
5. *To Understand and analyze the data representation and memory Hierarchy of the computer system*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Digital Logic Circuits and Components: Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit.
Register Transfer and Microoperations: Register Transfer Language, Bus and Memory Transfers, Arithmetic, Logic and Shift Microoperations.

UNIT-II

Basic Computer Organization and Design: Stored Program Organization and Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output, Interrupt.
Programming the Basic Computer: Machine Language, Assembly Language, Assembler, Program Loops, Subroutines, Input-Output Programming.

UNIT-III

Microprogrammed Control: Control Memory, Address Sequencing, Design of Control Unit
Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing Array Processors.

UNIT-IV

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.
Memory Hierarchy: Main Memory, Auxillary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.
Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.

Suggested Readings:

1. Morris Mano, "*Digital Logic and Computer Design*", Prentice- Hall of India, 1st edition, 1979.
2. William Stalling, *"Computer Organization & Architecture"*, Prentice Hall; 6th Edition, 2002 .
3. Kai Hwang, *"Advanced Computer Architecture*", McGraw Hill International, 1st edition, 1992.

MCA-20-132 Discrete Mathematics

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To learn the basics of fuzzy logic and its applications.*
2. *To learn propositional and predicate logic.*
3. *To learn counting principles*
4. *To learn the concepts and applications of Lattices*
5. *To learn the concepts of trees and graphs*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT- I

Fuzzy Logic: Introduction to fuzzy Logic, Classical and Fuzzy Sets,Overview of Classical Sets, Membership Function, Fuzzy Rulegeneration. Operations on Fuzzy Sets: Compliment, Intersection, Union,Combination of Operations, Aggregation Operation.
Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Classical Logic, Multi-Valued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges.

UNIT-II

Propositional Logic:Proposition, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference Predicate Logic: First order predicate, well-formed formula of predicate, quantifiers, Inference theory of predicate logic.

UNIT-III

Counting: Pigeonhole Principle, Inclusion-Exclusion Principle, Permutations and Combinations, Binomial Coefficients, Counting Principles, Applications.

Lattices: Lattices as partially ordered sets, their properties. Lattices and algebraic systems. Sub lattices, direct products and homomorphism. Some special lattices for example complimented and distributive lattices.

UNIT-IV

Graphs: Introduction, Terminology, Types of Graphs, Representation of Graphs, paths and Circuits, Cutset and Cut - Vertices, Graph Isomorphism, Homomorphism, Connectivity, Bipartite Graphs, Kurtowski's Theorem, Subgraphs, Operations on Graphs, Euler and Hamiltonian Paths, Shortest Path Problem, Planar & Dual Graphs, Coloring Covering and Partitioning.
Spanning Trees. Cut-sets. Fundamental Cut-sets and Cycle.
Tree: Tree Notations, Properties of tree, Types of Tree, Minimal Spanning Trees and Kruskal's Algorithm.

Suggested Readings:

1. Kenneth G. Rosen, "*Discrete Mathematics and Its Applications*", Tata McGraw Hill, 7th edition, 2012.
2. Koshy T, "*Discrete Mathematics with Applications*", Elsevier India, 1st edition, 2003.
3. M. Ganesh , "*Introduction to Fuzzy sets and Fuzzy Logic*", PHI , 2006
4. Eric Gosett, "*Discrete Mathematics with Proof*", Wiley India Pvt. Ltd, 2nd edition, 2010.
5. Seymour Lipshutz, "*Shaum's Outlines of Discrete Mathematics*", Tata McGraw Hill, 3rd edition, 2009.

MCA-20-201 Data and File Structures

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To Understand the concepts of data types, data structure like arrays, records, linked list, stacks, queues, trees and graphs and their memory representation and Applications*
2. *To learn various searching and sorting algorithms*
3. *Apply fundamental algorithmic problems including Tree traversal, graph traversal and their applications.*
4. *To understand the file system.*

Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Fundamentals of algorithm analysis: Big 'O' notations, Time and space complexity of algorithms, Elementary data structures and their applications
Arrays: ordered lists, representation of arrays, sparse matrices, linked lists: singly and doubly linked lists, stacks, queues, multiples stacks and queues, Applications: polynomial arithmetic, infix, postfix and prefix arithmetic expression conversion and evaluations.

UNIT-II

Lists, Stacks & Queues: Abstract Data Types, Representation & implementation of linked list, Doubly linked list, Circular linked lists, Stacks, array representation of stack. Applications of stacks. Queues, array representation of Queues, Circular queues, Deques, priority queues, Applications of Queues.

UNIT-III

Trees: Introduction to trees, binary trees, representation and traversal of trees, operations on binary trees, types of binary trees, threaded binary trees, B Trees, AVL Trees, Application of trees.
Graphs: Representation, traversal, connected components, shortest path and transitive closure, topological sort, activity network, critical path, path enumeration. Dijkstra's Algorithm, Floyd Warshall's Algorithm, Minimum Spanning Tree Definitions.

UNIT-IV

Searching & Sorting: searching techniques, Hash function, Hash table, Internal sort: Radixsort, Insertion sort, Exchange sort, Selection sort, Quicksort, Mergesort, Heaport, External sort: K-way mergesort, balanced mergesort. Files: Files, Queries and sequential organization; Cylinder surface indexing, Hashed Indexed, Tree Indexing, Sequential file organizational, random file organization, Hashed file organization, Inverted files, cellular partitions.

Suggested Readings:

1. E. Horowitz and S. Sahani, "*Fundamentals of Data Structures*", GalgotiaBooksource Pvt. Ltd, 1999.
2. Mark Allen Weiss , "*Data Structures & Algorithm Analysis in C++",* Second edition, Pearson Edition. Asia,1996.
3. A.V. Aho, J.E. Hopcroft and T.D. Ullman , "*Data Structures and Algorithms*", Original edition, Addison-Wesley, 1999, Low Priced Edition.
4. John Hubbard, "*Schaum's Outline of Data Structures with C++"*, McGraw-Hill Education , 2000.

MCA-20-202 Software Laboratory - VII

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To Understand the concepts of data types, data structure like arrays, records, linked list, stacks, queues, trees and graphs and their memory representation and Applications*
2. *To learn various searching and sorting algorithms*
3. *Apply fundamental algorithmic problems including Tree traversal, graph traversal and their applications.*
4. *To understand the file system.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-201.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-203 Programming with Java

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the features and concepts of Java language.*
2. *To deal with the Array, packages and exception handling concepts.*
3. *To know about how multi-threaded applications are designed in Java.*
4. *To understand the concept of Input/Output and Applet programming.*
5. *To provide an understanding of Event handling and GUI programming.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: Java Features, Java Virtual Machine (JVM), Byte code, Java API, Java Development Kit (JDK), Garbage Collection.
Language Basics: Keywords, Constants, Variables and Data Types, Operators and Expressions, Decision Making , Branching and Looping.
Introducing Classes, Objects and Methods: Defining a Class, Methods Declaration, Creating Objects and accessing Class members, Constructors, Methods Overloading, Wrapper Classes, Inheritance, Methods Overriding, Final Class, variables and methods, Abstract Class and Methods, Interfaces.

UNIT-II

Arrays, Strings and Vectors: Creating and using Arrays, String operations, String Buffer, String Builder, and StringTokenizer class, Vector class.
Packages and Exceptions: Java API packages, Creating and using packages, static import, Exceptions handling, Types of Exceptions, multiple catch statements, 'throw' and 'throws', using 'finally' statement, Creating your own exceptions.

UNIT-III

Multithreaded Programming: Single threaded and multi-threaded program, Creating threads using Thread class, Life cycle of a Thread, Stopping and blocking a Tread, getting and setting the Thread Priority, Synchronization, implementing the Runnable interface.

Managing Input/Output Streams: Concept of streams, Byte and Character streams, Reading and Writing from Console and Files. Input output exceptions.

UNIT-IV

Applet Programming: How Applets differs from Java Application, Applet Life Cycle, APPLET Tag, Running an Applet, Passing Parameters to Applet.
Event Handling: Mechanism, The Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter and inner classes.
GUI Programming: Working with Frame Window, Graphics and Text, AWT Controls and classes. Layout Managers, working with Menus.

Suggested Readings:

1. E. Balagurusamy, "*Programming with Java :A Primer*", McGraw Hill, 3rd edition.
2. Herbert Schildt, "*Java:The Complete Reference"*, McGraw Hill, 7th edition.
3. Bruce Eckel, "*Thinking in Java"*, Prentice Hall, 4th Edition.
4. Cay S. Horstmann, Gary Cornell, "*Core Java Volume I—Fundamentals"*, Prentice Hall, 9th Edition.

MCA-20-204 Software Laboratory - VIII

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the features and concepts of Java language.*
2. *To deal with the Array, packages and exception handling concepts.*
3. *To know about how multi-threaded applications are designed in Java.*
4. *To understand the concept of Input/Output and Applet programming.*
5. To provide an understanding of Event handling and GUI programming.

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-203.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	1**5**

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-211 PHP

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the basics of PHP.*
2. *To know about state management, Pattern matching.*
3. *To provide the information about Exception handling.*
4. *To get an idea about Notifications and Writing APIs.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Variables,Constant, Data types, Operator and Expression Handling, Making Decisions,Iterations, Function ,Call by value, Call by reference, Recursive function, Strings,Arrays,Index based and Associative array, each() and foreach(), Working with file and Directories, State management , Regular expression, Pattern matching

UNIT-II

Introduction to OOPS, Objects,Class , Constructor Destructor, $this variable, Public ,private, protected properties, Inheritance, code reusability, Polymorphism Parent:: & self:: keyword,Instanceof operator, Abstract method and class Interface, Final Exception Handling Understanding Exception and error Try, catch, throw.

UNIT-III

Introduction to LARAVEL, Installation, Creating a New Laravel Project, Laravel's Directory Structure, Basic Artisan commands, Routes, Controllers,Views, CSRF Protection, Database Eloquent: configuration, Migration, Seeding, Query Builder User Authentication and Authorization , Middleware.

UNIT-IV

Writing APIs : The Basics of REST - Like JSON APIs, Controller Organization and JSON

Returns Mail , Notifications , Normal Search V/s Full-Text Search with Laravel Scout

Suggested Readings:

1. Steven Holzner, *"PHP: The Complete Reference"*, McGraw Hill Education, 2017
2. Robin Nixon, "*Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5*", O'Reilly Media; 5th Edition,2018.
3. Larry Ullman, *"PHP Advanced and Object-Oriented Programming: Visual QuickPro Guide"*, Peachpit Press, 2012.
4. Luke Welling, Laura Thomson, *"PHP and MySQL Web Development",* Pearson Education, 2016.

MCA-20-212 Software Laboratory - IX

Maximum marks: 60 **External:** 42
Time: 3 hours **Internal:** 18
Credit: 3

Course Objectives:

1. *To understand the basics of PHP.*
2. *To know about state management, Pattern matching.*
3. *To provide the information about Exception handling.*
4. *To get an idea about Notifications and Writing APIs.*

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Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-211.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	1**5**

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-213 XML

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To provide the concept of designing XML documents.*
2. *To understand the design of Document Type Definitions.*
3. *To know the relationship between XML and CSS.*
4. *To provide and understanding of other Supplemental Technology and XML Applications.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introducing XML: What is XML, The Life of an XML Document, XML Applications, Creating, Saving and loading XML file into a Web Browser, Assigning Meaning to XML Tags, Writing and attaching a Style Sheet to an XML document, Structure Data, Attributes, Empty Tags and XSL, Well-formedness rules.

UNIT-II

Document Type Definitions: DTD element declarations, DTD Files, Internal DTDs, Internal and External DTD subsets, Public DTDs, DTDs and style sheets, Validating against a DTD, Entity Declarations, Attribute Declarations, Unparsed Entities, Namespaces.

UNIT-III

Style Languages: Cascading Style Sheets, Attaching style sheets to documents, DTD and Style sheets, Selecting Elements, Importing style sheets, CSS Units, Display Properties, Box Properties , Size and Positioning , CSS Text styles, Overview of XSL Transformations.

UNIT-IV

Supplemental Technology: XLinks versus HTML Links, Linking Elements, Link Behavior, XPointers, Location Paths, Steps, and Sets, Root Node, Axes, Resource Description Framework, Basic RFD Syntax.
XML Applications: XHTML, What's new in XHTML, Wireless Markup Language (WML), Schemas, Scalable Vector Graphics (SVG).

Suggested Readings:

1. Elliotte Rusty Harold, "*XML Bible*", John Wiley & Sons, 2nd Edition, 1999.
2. Erik T. Ray, "*Learning XML*", O'Reilly, 2nd Edition
3. Joe Fawcett, Danny Ayers, Liam R. E. Quin, "*Beginning XML*", Wrox Publications, 5th Edition, 2012.
4. Simon St. Laurent, Michael James Fitzgerald, "*XML Pocket Reference: Extensible Markup Language"*, O'Reilly, 3rd Edition, 2005.

MCA-20-214 Software Laboratory - X

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To provide the concept of designing XML documents.*
2. *To understand the design of Document Type Definitions.*
3. *To know the relationship between XML and CSS.*
4. To provide and understanding of other Supplemental Technology and XML Applications.

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-213.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	1**5**

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-221 Data Warehousing and Mining

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand formation of Data Warehouse.*
2. *To understand schemas and processes in Data Warehousing.*
3. *To understand concept of Data Mining.*
4. *To study Descriptive and Predictive Data Mining.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction to Data Warehouse, Data Warehouse Delivery Methods.
System Process : Typical Process Flow within a Data Warehouse, Extract and Load Process, Clean and Transform Data, Backup and Archive Process, Query Management Process.Process Architecture: Load Manager, Warehouse Manager, Query Manager, Detailed Information, Summary Information, Metadata, Data Marting
Database Schema: Starflake Schema, Snowflake Schema, Fact Constellation Schema, Identifying facts and dimensions, Designing Fact Tables, Designing Dimension Table, Designing various schema, Query Redirection

UNIT-II

Partitioning Strategy: Horizontal Partitioning, Vertical Partitioning, Hardware Partitioning, Sizing the partition.
Aggregations: Need of Aggregation, designing summary tables
Data Mart: Introduction, Need of Data Mart, Design of Data Mart, Cost of Data Mart.
Metadata: Data Transformation and Load, Data management, Query Generation, Metadata and tools.
Process Managers: Need of tools to manage data warehouse, system managers, data warehouse process managers, load manager, warehouse manager, query manager.

UNIT-III

Knowledge Discovery in Databases :Kamber's Model of KDD, Types of Data Mining, Major Issues in Data Mining.
Data Preprocessing : Data Cleaning, Data Integration and Transformation, Data Reduction, Data Transformation, Data Discretization.
Predictive Data Mining : Classification by Decision Tree Induction, Classification by Bayesian Method, Classification by Rule Based Method, Classification by Backpropagation, Classification by Support Vector Machine, Classification by Rough Set Theory, Classification by Fuzzy Approach, Classifier Accuracy Measures : Confusion Matrix and ROC curves.
Prediction by Linear Regression, Prediction by Non Linear Regression, Predictor Error Messages, Methods to increase accuracy of prediction.

UNIT-IV

Descriptive Data Mining : Association Rule Mining: Market Basket Analysis, Types of Association Rules, Methods of Mining Association Rules in Transactional Databases, Pattern Evaluation Methods, Pattern Mining in Multidimensional Space, Constraint Based Frequent Pattern Mining, Mining High Dimensional Data, Compressed or Approximate Patterns.
Clustering : Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data, Constraint Based Cluster Analysis, Outlier Analysis.

Suggested Readings:

1. Berson Alex, Smith Stephen J., "*Data Warehousing, Data Mining and OLAP"*, Tata McGraw Hill, 2008.
2. Anahory Sam, Murray Dennis, "*Data Warehousing in the Real Word"*, Pearson Education, 2009.
3. Jiawein Han, Jian Pein, Micheline Kamber, " *Data Mining : Concept and Techniques*", Morgan and Kauffman Publisher, 2011.
4. Mohammed J Zaki, Wagner Mira Jr, " *Data Mining and Machine Learning*", Cambridge University Press, 2020

MCA-20-222 Software Laboratory - XI

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand formation of Data Warehouse.*
2. *To understand schemas and processes in Data Warehousing.*
3. *To understand concept of Data Mining.*
4. *To study Descriptive and Predictive Data Mining.*

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Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-221.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-223 Python Libraries and R Packages

Maximum marks: 40
Time: 2 hours

External: 32
Internal: 08
Credit: 2

Course Objectives:

1. *To understand Python Libraries.*
2. *To understand R Packages.*
3. *To implement Python Libraries in Real Time Situations.*
4. *To use R Packages in Real Time Situations.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: Data analysis: Ideation, Retrieval, Preparation, Exploration, Modeling, Presentation, Reproduction.
Importing pandas. Panda series, Panda data frames, Loading data from files into a dataframe.
Representing Univariate data with the series: Configuring pandas, Creating a series, Size and shape of a series, Retrieving value in a series by label or position.

UNIT-II

Manipulating data frame structure: Renaming columns, Adding new column with: [] and insert{}, through enlargement, concatenation, Replacing the content of column, Deleting column, Appending new rows, Concatenating rows.
Numerical and Statistical Method: Performing arithmetic on a data frame or series, Getting the count of values, Determining unique values, Finding minimum and maximum values, Locating n smallest and n largest values, Calculating the accumulated values
Calculating mean, Finding median, Determining the node, Measuring variance, Finding the standard deviation, Calculating covariance and determining correlation. Executing random sampling of data.

UNIT-III

Introduction to R Packages, Package Structure, R Code, Package Metadata, Object Documentation, Vignettes,

UNIT-IV

Testing, Name Space, External Data, Compiled Code, Installed files, Git and GitHub, Automated Checking, Releasing R Package.

Suggested Readings:

1. Michael Heydt, "*Learning Pandas: High performance data manipulation and analysis using Python "*, Packt Publishing Limited, 2nd Edition.
2. Fabio Nelli, "*Python Data Analytics"*, A Press, 1st Edition.
3. Hadley Wickham, "*R Packages : Organize, Test, Document and Share your Code*", O' Reily, 2015.

MCA-20-224 Software Laboratory - XII

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand Python Libraries.*
2. *To understand R Packages.*
3. *To implement Python Libraries in Real Time Situations.*
4. *To use R Packages in Real Time Situations..*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-223.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-231 Research Methods in Computer Science

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To understand importance of research methods in research.*
2. *To provide an overview of various techniques of data collection.*
3. *To provide detail of sampling types.*
4. *To understand meaning of research surveys.*
5. *To provide detail of report generation.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

The Research Enterprise: What Is Research? Translational Research. Research Syntheses & Guidelines. Evidence-Based Practice.
Conceptualizing Research: Where Research Topics Come From. The Literature Review. Feasibility Issues.
The Language of Research: Research Vocabulary. Types of Studies. Time in Research. Types of Relationships. Hypotheses. Variables. Types of Data. The Unit of Analysis. Deduction and Induction. The Validity of Research.
Qualitative Methods: Participant Observation. Direct Observation. Unstructured Interviewing. Case Studies. Focus Groups.

UNIT-II

Foundations of Sampling. Sampling Terminology. External Validity in Sampling. Sampling Methods.
Nonprobability Sampling: Accidental, Haphazard, or convenience Sampling. Purposive Sampling. Modal Instance Sampling. Expert Sampling. Quota Sampling. Heterogeneity Sampling. Snowball Sampling.
Probability Sampling: Theory: The Sampling Distribution. Sampling Error. The Normal Curve in Sampling.

UNIT-III

Foundations of Survey Research. Types of Survey Research: Questionnaires. Interviews. Selecting the Survey Method:Population Issues. Sampling Issues. Question Issues. Content Issues. Bias Issues. Administrative Issues.

Survey Design: Types of Questions. Question Content. Response Format. Question Wording. Question Placement. The Golden Rule.
Interviews: The Role of the Interviewer. Training the Interviewers. The Interviewer's Kit. Conducting the Interview. Obtaining Adequate Responses-The Probe. Recording the Response. Concluding the Interview.

UNIT-IV

Experimental Design: Foundations. Origin of Experimental design: Distinguishing Features of Experimental Design. Experimental Design and Threats to Internal Validity. Design Notation for a Two-Group Experimental Design. Difference between Random Selection and Assignment.
Classifying Experimental Designs.
The Written Report: Key Elements and Formatting of a Research Paper. Other Forms of Research Communication: Presentations, posters.

Suggested Readings:

1. William Trochim, Ph.D., James P. Donnelly, Kanika Arora, *"Research Methods: The Essential Knowledge Base"*, Cengage publications, 2nd edition, 2016.
2. Singh, Y. K.," *Fundamental of Research Methodology and Statistics*", New International (P) Limited, 2006.
3. Wallinman, N.,"*Your Research Project: A step-by-step guide for the first-time researcher",* Sage Publications, 2006.

MCA-20-232 Theory of Computation

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To understand the fundamental concepts of Finite state Systems and Nondeterministic finite automata (NFA), Deterministic finite automata (DFA),*
2. *To understand the formal grammars and Chomsky hierarchy of grammars.*
3. *To learn about Regular Grammar and Regular Sets, Context Free and Context Sensitive Grammars*
4. *To understand push down automata, linear bounded automata and Turing machines.*
5. *To understand the concepts of decidability and Computability.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT - I

Finite State Machines: Finite Automata, Designing of DFA and NFA, NFA with E-Transitions, Equivalence of DFA and NFA with proof, Regular Expressions and Regular languages, Laws of Regular Expressions, Kleene's Theorem 1 and 2, Properties and Limitations of FSM, FSM with Output: Moore and Mealy Machines, Arden's Theorem with proof, Closure Properties of Regular Sets, Pumping Lemma for Regular Grammers, Myhill-Nerode Theorem, Minimization of FA.

UNIT - II

Formal Grammars: Definition, Construction of Context Free Grammar, Derivation, Parse Trees, Ambiguity, Removal of Ambiguity, Simplification of Context Free Grammar, CNF and GNF, Closure properties of CFL, Pumping Lemma for CFL.
Pushdown Automaton: Introduction, Types of PDA, Designing of PDA's, Conversion from PDA to CFG and vice-versa, Applications, Parsing: Early's, Cook-Kasami-Young, Tomito's.

UNIT – III

Linear Bounded Automata (LBA), Turing Machines (TM), variants of TM: Multitape, Restricted and Universal TM; TM and Computers. Recursive and recursively-enumerable languages and Properties.
Decidability: Post's correspondence problem, Cook's Theorem, decidability of membership, emptiness and equivalence problems of languages.

UNIT – IV

Decidable languages and problems, Halting problem of TM, Diagonalization method, Turing machines and other undecidable problems.
Computable Functions: Primitive recursive functions, Recursion theorem. Russels's Paradox, Tractable and Intractable problems, Computability and Non-computability and examples of non-computable problems.

Suggested Readings:

1. John C. Martin, "*Introduction to languages and the theory of computation"*, McGraw Hill, 2003.
2. K. L. P. Mishra, N. Chandrasekaran , "*Theory of Computer Science: Automata, Languages and Computation*", Prentice-Hall of India, 3rd edition, 2006.
3. Hopcroft, J. E. & Ullman, J. D., *"Formal languages and their relation to Automata*", Pearson Education, 2001.

Open Elective
Computer Fundamentals

(Course Code to be assigned by Examination Branch)

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To understand the components of computer, software, hardware.*
2. *To provide an overview of peripheral devices.*
3. *To provide internet, multimedia and animation concepts.*
4. *To get familiar with Windows Operating System.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Computer Fundamentals: Computer components, Generations of computers, Characteristics and classification of computers, hardware, software, firmware, Memory and its types: Random access, sequential access, Magnetic disk, optical disc, flash memory, Programming languages: Low level programming languages, High level languages, Assembler, Complier, Interpreter.

UNIT-II

Peripheral devices**:-**Keyboard, Pointing Devices: Mouse, Trackball, Touch Panel, Joystick, Light Pen, Scanners, Monitor, OMR, Bar-code Reader, Hard Copy Devices: Impact and Non-Impact Printers-Daisy Wheel, Dot Matrix, Laser Printer, Plotters, speakers, Projector.

UNIT-III

Internet and Multi Media: What is Internet?, Advantages and Disadvantages of Internet, Electronic Mail, Attaching a document with e- mail, FTP, Telnet, World Wide Web, Uniform Resource Locator (URL), Web Browsers, Internet Search Engine, What is Multimedia?, Multimedia Components: Text, Graphics, Animation, Audio, Video, Multimedia applications.

UNIT-IV

Using Windows Operating System: What is an Operating System, Main functions of an Operating System, Starting Windows, Using the Mouse, Start Menu, Shutting Down, Customizing the Desktop, Maximizing Minimizing Restoring Moving Resizing and Closing an Application Window, Control Panel , Taskbar, Window Explorer, Creating new Folder or File,

copying and moving files and folders, Recycle Bin, Using System Tools, User Accounts, Creating Shortcuts on Desktop, Windows Media Player, Windows accessories.

Suggested Readings:

1. Sinha, P. K., Sinha, Priti, "*Computer Fundamentals*", BPB Publications, 6th Edition.
2. Rajaraman, V., Adabala, N., "*Fundamentals of Computers*", PHI, 6th Edition, 2014.
3. Norton, Peter, "*Introduction to Computers*", Mc Graw Hill, 7th Edition, 2017.
4. Taxali, Ravi Kant, "*Computer Course*", Mc Graw Hill, 2014.

MCA-20-301 Artificial Intelligence

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the Domain of Artificial intelligence and basics techniques used for searching*
2. *To understand different methods of knowledge representation*
3. *To understand nature and goals of Neural computing*
4. *To understand the Fuzzy Logic and Arithmetic*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Basics of AI: Definition of AI, History, Domains AI, AI problems & State space, Some examples problems representations like Travelling Salespersons, Syntax analysis Problem, Basic issues to solve AI problems, Underlying assumptions, AI techniques, Level of model, Criteria for success, Control strategies.
Searching Techniques: DFS, BFS, Heuristic Search Techniques: Generate & Test: Hill Climbing (simple & steepest), Best first search/A*, Problem Reduction/AO*, Constraint satisfaction, Alpha-Beta pruning.

UNIT-II

Reasoning in logic : Brief revision of propositional and predicate logic. Different characterizations of reasoning. Generalized modus ponens. Resolution.
Forward and backward chaining. Knowledge Representation, Diversity of knowledge.
Inheritance hierarchies. Semantic networks. Knowledgebase ontologies. Handling uncertainty, Diversity of uncertainty. Inconsistency. Dempster-Shafer theory.

UNIT-III

Nature and Goals of Neural Computing: Comparison with rule-based AI. Overview of network architectures and learning paradigms. Binary Decision Neurons, The McCullough-Pitts model. Single-layer perceptrons and their limitations. The Multilayer Perceptron, The sigmoid output function.Hidden units and feature detectors. Training by error backpropagation. The error surface and local minima. Generalisation, how to avoid overtraining.

UNIT-IV

Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function,Fuzzy rule generation.
Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, AggregationOperations.
Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals; Numbers,Lattice of Fuzzy Numbers, Fuzzy Equations.
Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, LinguisticHedges.

Suggested Readings:

1. R. Beale, T. Jackson, " *Neural Computing-an introduction*", CRC Press, 1990.
2. Stuart Russell and Peter Norvig, "*Artificial Intelligence: A Modern Approach*", Prentice-Hall, 4th edition, 2020.
3. George J. Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic: Theory and Applications*" Prentice Hall, 1996.
4. M. Ganesh , "*Introduction To Fuzzy Sets And Fuzzy Logic*", PHI Learning, 2006.

MCA-20-302 Software Laboratory - XIII

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the Domain of Artificial intelligence and basics techniques used for searching*
2. *To understand different methods of knowledge representation*
3. *To understand nature and goals of Neural computing*
4. *To understand the Fuzzy Logic and Arithmetic*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-301.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-303 Operating System with Linux

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the architecture of Operating System.*
2. *To get an idea of system calls and processes.*
3. *To review the concept of C Compiler.*
4. *To know about the security issues and user management.*
5. *To understand the concept of shell programming.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT- I

Introduction: Basic features, architecture, distributions, Installation requirements; Kernel, Shell.
File System: boot block, super block, inode table, data blocks, accessing files, storage of files, standard directories, system calls for files, file and disk related commands, hard disk partitions; System startup and shut down processes, init and run levels, rc and init files.

UNIT–II

C language compiler, layout of C program in memory, process environment, kernel support, process images, managing zombie and orphan processes, use of makefiles, dependency calculations, dynamic loader, debugging with gdb.

UNIT – III

User Management: Adding new users and groups, super users, creating and mounting file systems. User management commands.
Security and Connections: viewing and changing the permissions and ownerships of files and directories, creating networks, Signal generation and handling, Environment variables, Commands: man, ping, ifconfig, raise, alarm, pause, abort etc.

UNIT – IV

Shell: meaning, types; connecting processes with pipes, tee, redirect input and output, background processes, managing multiple processes, changing priority, scheduling of processes, at, batch and cron commands, process related commands, filters.

Shell Programming: Introduction, shell programming in various shells, file name substitution, read command, operators, conditional statements, looping and case statements, expr statement, command line arguments, parameter passing and arguments, associative arrays, string and mathematical functions, arrays and functions, libraries, shell variables, shell programs to automate system tasks, interrupt processing, shell scripts for administrators, debugging shell scripts.

Suggested Readings:

1. Matthew Neil, Stones Richard, "*Beginning Linux Programming*", 4th Ed., Wiley India Pvt. Ltd, 2007.
2. John Goerzen, "*Linux Programming Bible*", Wiley; 1st Edition, 2000.
3. ChristopherNegus, "*Linux Bible*", 10th Ed., Wiley India Pvt. Ltd,2020.
4. Petersen Richard, "*Linux: The Complete Reference*", 6th Ed., Tata Mcgraw Hill,2007.
5. Venkateshmurthy M.G., "*Introduction to Unix & Shell Programming*", Pearson Education, 2009.

MCA-20-304 Software Laboratory - XIV

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To review the concept of C Compiler.*
2. *To implement the basic Linux commands*
3. *To design shell scripts to demonstrate the OS concepts.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-303.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work

MCA-20-311 Dot Net Framework and C#

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand .Net Framework and base classes*
2. *To know the basics of C# language.*
3. *To understand .Net Assemblies and Attribute.*
4. *To provide information about ASP.Net and ADO.Net*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

The .Net framework: Introduction, The Origin of .Net Technology, Common Language Runtime (CLR), Common Type System (CTS), Common Language Specification (CLS), Microsoft Intermediate Language (MSIL), Just-In –Time Compilation, Framework Base Classes.

UNIT-II

C -Sharp Language (C#): Introduction, Data Types, Identifiers, Variables, Constants, Literals, Array and Strings, Object and Classes, Inheritance and Polymorphism, Operator Overloading, Interfaces, Delegates and Events. Type conversion.

UNIT-III

C# Using Libraries: Namespace- System, Input-Output, Multi-Threading, Networking and sockets, Managing Console I/O Operations, Windows Forms, Error Handling.
.Net Assemblies and Attribute: .Net Assemblies features and structure, private and share assemblies, Built-In attribute and custom attribute. Introduction about generic.

UNIT-IV

Advanced Features Using C#: Web Services, Window Services, Asp.net Web Form Controls, ADO.Net. Distributed Application in C#, Unsafe Mode, Graphical Device interface with C#.

Suggested Readings:

1. Fergal Grimes,"*Microsoft .Net for Programmers*", Manning Publications, 2002.
2. E. Balagurusamy,"*Programming with C#*", Tata McGrawHill, 3rd Edition.
3. Karli Watson, Chrisian Nagel, Jacob Hammer Pedersen, Jon D. Reid, Morgan Skinner, Eric White,*"Beginning Visual C#"*, Wrox, *2008*
4. Mark Michaelis, "*Essential C# 3.0: For .NET Framework 3.5*", Pearson Education, 2nd Edition.

MCA-20-312 Software Laboratory - XV

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand .Net Framework and base classes*
2. *To know the basics of C# language.*
3. *To understand .Net Assemblies and Attribute.*
4. *To provide information about ASP.Net and ADO.Net*

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Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-311.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-313 Dissertation / Project Work

Maximum marks: 200

External: 160
(Evaluation :80
Viva Voce :80)
Internal: 40
Credit: 10

Guidelines :

1. Project Work will be supervised by Faculty Members of Department of Computer Science and Applications.
2. Supervisor of Project Work will be allotted by Staff Council in 2nd Semester.
3. Title of Project Work will be approved by Staff Council, Department of Computer Science and Applications.
4. Student will prepare proposal of Dissertation / Project Work just after completion of Examination of 2nd Semester.
5. Meeting of Staff Council for the purpose stated in Point No 3 will be held within 15 days of Commencement of 3rd Semester.
6. Student will publish at least one concept paper in reputed journal / present in national / international conference.
7. The Project Work will be evaluated by Internal and External Examiner as per MCA Ordinance.

MCA-20-321 Cloud Computing

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the concept of Clouding Computing.*
2. *To know about Seven Step Model of Migration into a Cloud.*
3. *To get familiar with Cloud Paradigms.*
4. *To know about Virtual Machine infrastructure and Security in Cloud.*
5. *To understand the Integration of Private and Public Cloud*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction to Cloud, Cloud Computing Reference Model, Distributed Systems, Virtualization, Web 2.0, Service Oriented Computing, Utility Oriented Computing, Parallel vs Distributed Computing.
Virtualization : Characteristics of Virtualiization Environment, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization.
Cloud Reference Model : Architecture, SAAS, PAAS, IAAS.

UNIT-II

Types of Cloud : Public, Private, Hybrid, Community.
Economics of Cloud.
Concurrent Computing : Programming Applications with Threads, Multithreading, Domain Decomposition, Functional Decomposition.
Task Computing : Characterizing a Task, Computing Categories, Framework for Task Computing.
Task Based Application Models : Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependency.

UNIT-III

Data Intensive Computing : Characterizing Data Intensive Computing, Challenges Ahead, Historical Prespectives, Storage System, Programming Platforms, Map Reduce Programming.
Cloud Platforms in Industry : Case Study of Amazon Web Services, Google App Engine, Microsoft Azure.

UNIT-IV

Scientific Applications of Cloud : Healthcare, Protein Structure Prediction, Gene Expression Data Analysis, Satellite Image Processing.
Business and Consumer Applications of Cloud : CRM, ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming.
Energy Efficient and Green Cloud Computing Architecture.
Market Based Management of Cloud : Market Oriented Cloud Computing, Reference Model for Market Oriented Cloud Computing, Technologies and Initiative Supporting Market Oriented Cloud Computing, Observations.
Federal Cloud / Inter Cloud : Characterization and Definition, Cloud Federation Stack, Aspects of Interest, Technologies for Cloud Federations, Observations.
Third Party Cloud Service.

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola and S. ThamaraiSelvi, "*Mastering Cloud Computing"*, McGraw Hill Education, 2016.
2. Lizhe Wang, Rajiv Ranjan, Jinjun Chen and BaualemBenatallah, "*CludComputing : Methodology Systems and Applications"*, CRC Press, 2012.
3. Kris Jamsa, "*Cloud Computing"*, Jones and Bartlett Learning, 2013.
4. NayanRuparelia, "*Cloud Computing",* MIT Press, 2015

MCA-20-322 Software Laboratory - XVI

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the concept of Clouding Computing.*
2. *To know about Seven Step Model of Migration into a Cloud.*
3. *To get familiar with Cloud Paradigms.*
4. *To know about Virtual Machine infrastructure and Security in Cloud.*
5. *To understand the Integration of Private and Public Cloud*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-321.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-323 Dissertation / Project Work

Maximum marks: 200

External: 160
(Evaluation :80
Viva Voce :80)
Internal: 40
Credit: 10

Guidelines :

1. Project Work will be supervised by Faculty Members of Department of Computer Science and Applications.
2. Supervisor of Project Work will be allotted by Staff Council in 2nd Semester.
3. Title of Project Work will be approved by Staff Council, Department of Computer Science and Applications.
4. Student will prepare proposal of Dissertation / Project Work just after completion of Examination of 2nd Semester.
5. Meeting of Staff Council for the purpose stated in Point No 3 will be held within 15 days of Commencement of 3rd Semester.
6. Student will publish at least one concept paper in reputed journal or present in national / international conference.
7. The Project Work will be evaluated by Internal and External Examiner as per MCA Ordinance.

MCA-20-331 Design and Analysis of Algorithms

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit : 5

Course Objectives:

1. *To understand the concept of Algorithm Design.*
2. *To know about various Sorting techniques.*
3. *To get familiar with Dynamic Programming and Greedy algorithms.*
4. *To understand NP-complete problems and String matching.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: Analyzing algorithms, Designing algorithms, asymptotic notation, Standard notations and common functions, the substitution method, the recursion tree method, the master method.
Sorting: Heaps- maintaining the heap property, building a heap, The heapsort algorithm, description of quick sort, performance of quicksort, Analysis of quicksort, Lower bounds for sorting-Counting sort, Radix sort, Bucket sort.

UNIT-II

Dynamic Programming: Assembly-line scheduling, Matrix chain multiplicationelements of dynamic programming, longest common subsequence, optimal binary search trees.
Greedy algorithms: An activity selection problem, Elements of greedy strategy, Huffman codes, a task scheduling problem.

UNIT-III

Graph algorithms: Representation of graphs, Breadth first search, Depth first search, Topological sort, strongly connected components, Growing a minimum spanning treeKruskal and Prims algorithms, Single source shortest paths in directed acyclic graphs-The Bellman-Ford Algorithm, Dijkstra's Algorithm. All pairs shortest paths and matrix multiplication- The Floyd-Warshall algorithm, Johnson's algorithm for sparse matrices.

UNIT-IV

NP-completeness: Polynomial time and its verification-NP-completeness-reducibilityproofs and NP-complete problems- The vertex cover problem, The travelling salesman's problem, The set cover problem-Randomization and linear programming, The subset-sum problem.
String Matching: the naïve string matching algorithm, the Rabin Karp algorithm, string matching with finite automata, the Knuth-Morris-Pratt algorithm**.**

Suggested Readings:

1. Thomas H. Corman, Charles E. Leiserson, Ronald R. Rivest& Clifford Stein , *"Introduction to Algorithms*", MIT Press, 3rd Edition, 2009.
2. Aho, Hopcroft and Ullman , "*The Design and Analysis of Computer Algorithms*", Pearson Education, 2nd Edition.
3. Michel T. Goodrich & Roberto Tamassia, "*Algorithm Design and Applications"*, Weily, 1st Edition, 2014.

MCA-20-332 Dissertation / Project Work

Maximum marks: 200

External: 160
(Evaluation :80
Viva Voce :80)
Internal: 40
Credit: 8

Guidelines for Supervisor :

1. The Supervisor should hold Ph.D. Degree.
2. The Supervisor should be internal only.
3. Name of Supervisor will be allotted by Staff Council, Department of Computer Science and Applications.
4. The candidate will start to prepare proposal for Dissertation / Project Work just after completion of examination of 2nd Semester.
5. Meeting of Departmental Research Committee will be held within 15 days of commencement of Semester.
6. Vice Chancellor, if find essential may allow the Co-Supervisor on recommendation of Departmental Research Committee, Department of Computer Science and Applications, Chaudhary Ranbir Singh University, Jind
7. The candidate needs to publish at least one research paper in reputed journal or present in national / international conference.
8. Dissertation will be evaluated by Internal and External Examiners as per MCA Ordinance.

Open Elective
Office Automation Tools

(Course Code to be assigned by Examination Branch)

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To understand the important Application software used in office automation.*
2. *To provide the concepts word processing software for document writing.*
3. *To provide internet, multimedia and animation concepts.*
4. *To get familiar with Windows Operating System.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Word Processing: Starting Word Processing software, Creating and saving a document, Opening a document, Inserting, selecting, copying, moving, deleting and pasting, text, Undoing ,redoing, Applying bold, italic, underline style on text, changing size, color and font of text, using Format painter, aligning text, Formatting paragraphs: Line spacing, paragraph indents, space before and after paragraph, using bullets and numbering in paragraphs, Spelling and grammar, Autocorrect, inserting page number, page break, header and footer, border and shading, inserting picture, shapes and screenshot, Inserting Table of Contents, In-text Citation and References, Using Mail merge.

UNIT-II

Spreadsheet Designing**:** Starting Excel, Workbook and Worksheet or Spreadsheet, Aligning and formatting data in cells, Cell range, Math, Trigonometric, Date and Time, Logical, Text and Statistical Functions, AutoSum, inserting/deleting rows, columns and cells, Merge and center, creating charts (column, line, pie, bar), changing column width and row height, using IF() function, Sorting data, Filtering data.

UNIT-III

Lookup and Reference Functions, Database Functions, Information Functions, Using conditional formatting with multiple cell rules, creating new rules and managing existing rules, Creating Pivot Table, Using Pivot Table Options, Changing and Updating Data Range, Formatting Pivot Table and making Dynamic Pivot Table, Creating Pivot Chart, Types of Pivot Charts and their usage, Formatting Pivot Charts and making Dynamic Pivot Charts.

UNIT-IV

Presentation Designing: Starting Presentation software, Creating New Presentation, adding slides, Entering/Editing Text in Slides, Formatting text and paragraph, inserting a picture, Clip Art and Screenshot, Inserting Chart, Shapes, Word Art, Text Box, Inserting table, PowerPoint Views, Slideshow, Slide Transition Effects, Animation, Inserting Video and Audio, Printing Presentation Slides

Suggested Readings:

1. Taxali , Ravi Kant, *"Computer Course"*, Mc Graw Hill Education, 2014.
2. Saxena , Sanjay, *"A First Course in Computers"*, Vikas Publishing House, 2015.
3. Balagurusami , E., *"Fundamentals of Computers"*, Mc Graw Hill, 2009.
4. Weverka, Peter, *"Office 2010 All-in-One for Dummies"*, Wiley Publishing, Inc., 2010

MCA-20-401 Mobile Applications Development

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand the architecture of Android OS.*
2. *To provide an overview of setting up the development environment.*
3. *To understand various logical components of a Mobile Application.*
4. *To know about the life cycle of Activity and Services.*
5. *To understand the database connectivity with Mobile App.*
6. *To provide the concepts of Multimedia, Location, and Sensors.*
7. *To know about how to test and publish a Mobile App.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: mobility and mobile platforms, Android overview, Setting up Development environment, Mobile OS architectures of android, iOS and Windows, Android App project structure, Setting up an Android Virtual Device (AVD) or Emulator, Logical components of an Android App., Tool repository, installing and running App devices.

UNIT-II

Building Blocks: Activity- states and life cycle of an Activity, User Interface resources, events, interaction among Activities, working with Threads, Services- states and life cycle, Notifications, Broadcast receivers, Telephony and SMS APIs

UNIT-III

App data handling - Flat Files, shared preferences, Relational data- SQLiteDatabase, Graphics and animations- custom views, canvas, animation APIs, Multimedia- audio/video playback and record, location services and maps, Sensors.

UNIT-IV

Testing Mobile Application: debugging mobile application, White box testing, black box testing, and test automation of mobile apps using JUnit for android, Signing and packaging mobile apps, Distributing apps on market place.

Suggested Readings:

1. Anubhav Pradhan and Anil V. Deshpande, "*Composing Mobile Apps: Learn, Explore, Apply using Android"*, Wiley India, 1st Edition.
2. Valentino Lee, Heather Schneider, Robbie Schell, "*Mobile Applications: Architecture, Design, and Development"*, Hewlett-Packard Professional Books, 2004.
3. Barry A Burd, "*Android Application Development All-in-one for Dummies"*, John Wiley & Sons Inc., 1st Edition.
4. Jeff McWherter , Scott Gowell , "*Professional Mobile Application Development",* 1st Edition, WROX Publishing.

MCA-20-402 Software Laboratory - XVII

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the architecture of Android OS.*
2. *To provide an overview of setting up the development environment.*
3. *To understand various logical components of a Mobile Application.*
4. *To know about the life cycle of Activity and Services.*
5. *To understand the database connectivity with Mobile App.*
6. *To provide the concepts of Multimedia, Location, and Sensors.*
7. *To know about how to test and publish a Mobile App.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-401.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-403 Soft Computing

Maximum marks: 40
Time: 2 hours

External: 32
Internal: 08
Credit: 2

Course Objectives:

1. *To understand the Hard and Soft Computing.*
2. *To know about the concept of Neural Networks.*
3. *To get an idea of ANN Training algorithm.*
4. *To understand the Fuzzy Logic and Genetic Algorithm.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.
Neural Networks : History, Overview of Biological Neuro-System, Mathematical Models of Neurons, ANN architecture, Learning rules, Gradient Descent Algorithm, Learning Paradigms-Supervised, Unsupervised and Reinforcement Learning.

UNIT-II

ANN Training Algorithms-Perceptrons, Training Rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT-III

Fuzzy Logic : Membership functions, features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT-IV

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

Suggested Readings:

1. S.Rajasekaran, G. A. Vijayalakshami, *"Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications*", PHI, 2011.
2. M. Ganesh, "*Introduction to Fuzzy sets and Fuzzy Logic*", PHI, 2006
3. G. J. Klir, B.Yuan, "*Fuzzy sets and Fuzzy Logic: Theory and applications*", PHI, 1st Edition.
4. David Edward Goldberg, "*Genetic Algorithms in Search, Optimization and Machine Learning"*, Adddison Wesley, 2002.

MCA-20-404 Software Laboratory - XVIII

Maximum marks: 60
Time: 3 hours

External: 48
Internal: 12
Credit: 3

Course Objectives:

1. *To understand the Hard and Soft Computing.*
2. *To know about the concept of Neural Networks.*
3. *To get an idea of ANN Training algorithm.*
4. *To understand the Fuzzy Logic and Genetic Algorithm.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-403.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-405 Data Communication and Networking

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the Computer Networks and various types.*
2. *To provide an overview OSI and TCP/IP Models.*
3. *To understand the Communication model and Switching.*
4. *To provide an overview of Data Link Layer and Wireless LAN protocol.*
5. *To understand the concept of Network layer, Routing and Scheduling.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Introduction to Computer Networks and its uses, Network categorization and Hardware: Broadcast and point-to-point networks, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Internetworks, Topologies, Wireless networks, Network Software: Protocols, Services, network architecture, design issues, OSI Reference model, TCP/IP Reference model, Comparison of OSI and TCP/IP Models. Introduction to Example Networks: Internet, Connection-Oriented Networks – X.25, Frame Relay, ATM.

UNIT-II

Data Communication Model, Digital and Analog data and signals, bit rate, baud, bandwidth, Nyquist bit rate, Guided Transmission Media – Twisted Pair, Coaxial cable, Optical fiber; wireless transmission – Radio waves, microwaves, infrared waves; Satellite communication.
Switching: Circuit Switching, Packet Switching; Multiplexing: Frequency Division Multiplexing Time Division Multiplexing, Synchronous and Asynchronous TDM, Modems, Transmission Impairments, Manchester and Differential Manchester encoding, ADSL Versus Cable.

UNIT-III

Data Link Layer Design issues: Framing, error control, Flow Control, Error Detection and correction; Elementary Data Link Protocols, Sliding Window Protocols; Medium Access Control: Aloha, CSMA protocols, Collision free protocols, Limited Contention Protocols; Wavelength division Multiple access protocol, Wireless LAN Protocol: MACA; IEEE 802.3 Ethernet, IEEE 802.4 Token Bus; IEEE 802.5 Token ring, Binary Exponential Backoff algorithm, Digital Cellular, Radio: Global System for Mobile Communication (GSM), Code

Division Multiple Access(CDMA), Fiber Distributed Data Interface, Distributed Queue Dual Bus (DQDB).

UNIT-IV

Network Layer, Design issues , Virtual Circuit and Datagram Subnet, Routing Algorithms, Optimality principle, Shortest path Routing, Flooding , Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast and Multi Cast Routing, Routing for Mobile hosts, Routing in Adhoc Networks,, congestion Control Algorithms, General Principals Traffic Shaping, Leaky bucket token bucket, choke packets, Load Shedding.

Suggested Readings:

1. Andrew S. Tanenbaum, "*Computer Networks",* Pearson, 5th Edition.
2. Behrouz A Forouzan, "*Introduction to Data communications and Networking*", Tata Mc-Graw Hill, 4th Edition.
3. Prakash C. Gupta, *"Data Communications and Computer Networks", PHI, 2006.*

MCA-20-406 Software Laboratory - XIX

Maximum marks: 40
Time: 3 hours

External: 32
Internal: 08
Credit: 2

Course Objectives:

1. *To understand the Computer Networks and various types.*
2. *To provide an overview OSI and TCP/IP Models.*
3. *To understand the Communication model and Switching.*
4. *To provide an overview of Data Link Layer and Wireless LAN protocol.*
5. *To understand the concept of Network layer, Routing and Scheduling.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-405.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-411 Angular JS and Node JS

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To provide the understanding of core features and applications of Angular JS.*
2. *To give an idea of Directives and built-in Filters.*
3. *To understand modules, scopes and Services of Angular JS.*
4. *To provide an overview of Node.JS modules and Node Package Manager.*
5. *To understand the concept of Event handling and database connectivity in Node.js*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

AngularJS - Overview: Need of Angular JS, Applications of Angular JS, Core features, MVC Architecture
Directives: ng-app, ng-init, ng-model, ng-bind, ng-repeat, Directive Lifecycle, Binding Controls to Data, Matching Directives, Angular Expressions
Built in Filters, Using Angular JS Filters. Role of Controller, Controllers and Modules, Nested Controllers, Using Filters in Controllers

UNIT-II

Introduction to Angular JS Modules, Working with Angular forms, Model Binding Forms, Updating Models with a twist.
Scope, Scope Lifecycle, Scope Inheritance, Scope and Controllers, Rootscope, Scope Broadcasting.
Dependency Injection, Creating Services, Factory Service and Provider.

UNIT-III

Introduction to Node.gs, REPL Terminal, Node.js Modules, Module Types, Core Modules, Local Modules, Module Experts
Node Packet Manager (NMP), Installing Packages Locally, Adding dependency in Packages, Installing Packages Globally, Updating packages. Creating Web Server, Handling http requests, sending requests.
Buffers, Streams, Files, reading, writing, updating files, synchronous and asynchronous.

UNIT-IV

Events in Node JS, significance of the events, writing own events, Event Emitter class, inhering events.

Express framework to create web applications: Configuring Routes, Working with Express. How to serve Static HTML pages to the browser, and serving other file formats and restricting certain files.

Database Connectivity: MySQL Database**,** Creating Connection, Creating database and tables, Insert, Select, Delete , Update records.

Suggested Readings:

1. Ruebbelke L., "*Angular JS in Action"*, Manning Publications, 2015.
2. Sandro Pasquali, Kevin Faaborg, "*Mastering Node.js*", Packt Publishing Limited, 2017
3. Dhruti Shah,"*Node .Js*", BPB Publications, 1st edition, 2018.
4. Seshadri S., Green B., "*Angular JS Up and Running"*, O'Reilly, 2014.
5. Jim R. Wilson, "*Node.js the Right Way*", O'Reilly, 2013.
6. Alex Young, Bradley Meck, Mike Cantelon, Tim Oxley, Marc Harter, T.J. Holowaychuk, Nathan Rajlich , "*Node.js in Action*", Dreamtech Press; 2nd edition, 2017.

MCA-20-412 Software Laboratory - XX

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To provide the understanding of core features and applications of Angular JS.*
2. *To give an idea of Directives and built-in Filters.*
3. *To understand modules, scopes and Services of Angular JS.*
4. *To provide an overview of Node.JS modules and Node Package Manager.*
5. *To understand the concept of Event handling and database connectivity in Node.js*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-411.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-413 React JS and Django

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To provide the concept of React JS elements and life cycle.*
2. *To give an idea of Events, Flux and animation in React.*
3. *To understand the MVC design pattern and Django Project structure.*
4. *To provide an overview of Django Template System.*
5. *To understand the concept of Cookies and Session management in Django.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Overview of React JS, Environment setup, Creating React Elements with JavaScript, Rendering React Elements, Creating React Elements with JSX,
React Components, Stateless versus stateful, Using Props, validating Props, React Component Life cycle: Mounting, Updating, and Un-mounting.

UNIT-II

React Events: Adding Events, Event Handlers, React Forms: Adding Forms, Handling forms, conditional rendering,
React JS Refs, Keys, Router, Flux concept, React CSS, Animation.

UNIT-III

Introduction to Django, Installing Django, Model-View-Controller (MVC) Design Pattern, Django Project structure, Apps life cycle, Admin Interface, Creating Views, URLconf, Regular Expressions, Loose Coupling, Django's Pretty Error Pages.

UNIT-IV

Django Template System Basics, Creating Template Objects, Rendering a Template, Tags and Filters, Template Loading, The include Template Tag.
Django Models, Page redirection, Sending Email, Processing Forms, File uploading, Cookies handling, Sessions, Cashing.

Suggested Readings:

1. Artemij Fedosejev, *"React.js Essentials"*, Packt Publishing Limited, 2015
2. Alex Banks, Eve Porcello ,"*Learning React: Functional Web Development with React and Redux*", Shroff/O'Reilly; 1st edition, 2017
3. Nigel George,*"Mastering Django: Core: The Complete Guide to Django 1.8*", GNW Independent Publishing, 1st edition, 2016.
4. Aidas Bendoraitis, Jake Kronika, "*Django 3 Web Development Cookbook: Actionable solutions to common problems in Python web development*", 4th edition, Packt Publishing Limited, 2020
5. Greg Sidelnikov,*" React.js Book: Learning React JavaScript Library From Scratch"*, River Tigris LLC, 1st Edition, 2016
6. Adam Horton, Ryan Vice , *"Mastering React"*, Packt Publishing Limited, 2016
7. William S. Vincent, "*Django for Beginners: Build websites with Python and Django"*, Independently published, 2018
8. Antonio Mele, "*Django 3 By Example: Build powerful and reliable Python web applications from scratch"*, Packt Publishing, 3rd Edition,2020

MCA-20-414 Software Laboratory - XXI

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To provide the concept of React JS elements and life cycle.*
2. *To give an idea of Events, Flux and animation in React.*
3. *To understand the MVC design pattern and Django Project structure.*
4. *To provide an overview of Django Template System.*
5. *To understand the concept of Cookies and Session management in Django.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-413.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-421 Big Data Analytics

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand Big Data Platform and its usage.*
2. *To provide an overview of Apache Hadoop.*
3. *To provide HDFS concepts and interfacing with HDFS.*
4. *To understand MapReduce jobs.*
5. *To provide Hands on Hadoop Ecosystem.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Types of Digital Data, Introduction to Big Data, Big Data Analytics, Apache Hadoop, Analysing data with UNIX/ LINUX tools, Analysing data with Hadoop, Hadoop Ecosystem

UNIT-II

The concept and design of Hadoop Distributed File System, Command Line Interface, Data Flow, Data ingest with Floom and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File Based Data Structure

UNIT-III

Anatomy of MapReduce job run, failures, Job Scheduling, Shuffle and Sort, Task Execution, MapReduce types and formats, MapReduce features.
Introduction to PIG, Execution modes of PIG, Comparison of PIG with databases, Grunt, PIG Latin, User Defined Functions, Database Processing Operators

UNIT-IV

Hive Shell, Hive Services, Hive Metastore, Comparison with traditional databases, HiveQL, Tables, Querying data and user defined functions.
Hbase concepts, Clients, Hbase versus RDBMS, Introduction to BigSQL.

Suggested Readings:

1. DT Editorial Services, *"Big Data, Black Book",* Dreamtech Press, 1st edition, 2016.
2. Tom White,*"Hadoop: The Definitive Guide",* Shroff Publishers, 4th edition, 2015
3. Srinath Perera, Thilina Gunarathne, "*Hadoop MapReduce Cookbook",* Packt Publishing Limited, 2013.
4. Michele Chambers, Ambiga Dhiraj Michael Minelli, *"Big Data, Big Analytics*", Wiley, 2013.
5. Nathan Marz, James Warren, *"Big Data: Principles and Best Practices of Scalable Real-Time Data Systems",* Dreamtech Press, 2015.

MCA-20-422 Software Laboratory - XXII

Maximum marks: 40 **External:** 32
Time: 3 hours **Internal:** 08
Credit: 2

Course Objectives:

1. *To understand Big Data Platform and its usage.*
2. *To provide an overview of Apache Hadoop.*
3. *To provide HDFS concepts and interfacing with HDFS.*
4. *To understand MapReduce jobs.*
5. *To provide Hands on Hadoop Ecosystem.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-421.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-423 Programming with Julia

Maximum marks: 40 **External:** 32
Time: 2 hours **Internal:** 08
Credit : 2

Course Objectives:

1. *To understand the basics of Julia programming.*
2. *To know about the functions, flow control and exception handling in Julia.*
3. *To provide an overview of Julia Type System.*
4. *To get an idea of working with CSV files using DataFrames.*
5. *To understand the Object orientation and Collection concept.*
6. *To provide an overview of Meta programming and Graphics in Julia.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 6 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Julia environment: Introduction, Installing Julia, package management, What makes Julia special, Using Julia REPL.
Basics in Julia: Variables, Numbers, Elementary mathematical functions and operations, Characters, Strings, Regular expressions, Ranges and Arrays, Dates and times, Scope and constants.

UNIT-II

Functions: Defining functions, optional and keyword arguments, Anonymous functions, Broadcasting, Map, Filter and list comprehensions, Generic functions and multiple dispatch..
Control Flow: Control Flow, Conditional evaluation, Repeated evaluation, Exception handling.
Working with Types: Julia Type system, inspecting Types, Type Hierarchies and multiple dispatch, conversion and promotion, defining your own types.

UNIT-III

Input and output: Basic input and output, working with files, Different file formats. Using Modules, Reading and writing CSV files, Using DataFrames.
Object-Oriented programming Interfaces, Inheritance, functional programming in Julia: Higher order functions, function composition, functional approach.

UNIT-IV

Collections: Collection Types, multi-dimensional Arrays, Tuples, Dictionaries, Sets, Type Unions.

Meta-programming in Julia: Expressions and symbols, evaluation and interpolation, defining macros, built-in macros

Graphics in Julia, Using plots on Data.

Suggested Readings:

1. Ivo Balbaert, *Julia 1.0 Programming*, Packt Publishing Limited, 2nd Edition, 2018
2. Malcolm Sherrington, *Mastering Julia*, Packt Publishing Limited, 2015
3. Anshul Joshi, Rahul Lakhanpal, *Learning Julia*, Packt Publishing Limited, 2016
4. Anshul Joshi, *Julia for Data Science*, Packt Publishing Limited, 2016
5. Bogumil Kaminski, Przemyslaw Szufel, *Julia 1.0 Programming Cookbook*, Packt Publishing Limited, 2nd Edition, 2018
6. Ben Lauwens, Allen Downey, *Think Julia: How to Think Like a Computer Scientist*, Shroff/O'Reilly; First edition, 2019
7. Paul D. McNicholas and Peter Tait. "*Data Science with Julia*". Chapman and Hall/CRC, January 2019.

MCA-20-424 Software Laboratory - XXIII

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand the basics of Julia programming.*
2. *To know about the functions, flow control and exception handling in Julia.*
3. *To provide an overview of Julia Type System.*
4. *To get an idea of working with CSV files using DataFrames.*
5. *To understand the Object orientation and Collection concept.*
6. *To provide an overview of Meta programming and Graphics in Julia.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-423.
The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	8
b)	Execution of Programs	25
c)	Viva Voce	15

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.

MCA-20-431 Compiler Design

Maximum marks: 100 **External:** 80
Time: 3 hours **Internal:** 20
Credit: 5

Course Objectives:

1. *To learn the process of translating a modern high-level language to executable code.*
2. *To understand various parsing techniques.*
3. *To understand and generate various types of intermediate codes*
4. *To understand various code optimization techniques*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 8 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 24 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 14 marks.
Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

UNIT-I

Compilers and Translators, Lexical analysis, Syntax analysis, Intermediate code generation, Optimization, Code generation. Error, lexical phase errors, synthetic phase errors, semantic errors.

UNIT-II

Lexical Analysis: Process of lexical analysis, finite state automata, DFA and NFA, recognition of regular expressions, LEX.
Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.

UNIT-III

Parsing Techniques: top down & bottom-up parsing, Shift reduce parsing, operator precedence parsing, predictive parsers Automatic Construction of efficient Parsers: LR
parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables, constructing LALR sets of items.

UNIT-IV

Intermediate Code Generation: Issues in the design of a code generator, Intermediate
languages, generating intermediate code for declarative statement, assignment statement, Boolean expression, and case statement.
Code Optimization: potential cases of code optimization, optimization of basic blocks,
loops in flow graphs, code improving transformation.

Suggested Readings:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman., "*Compilers Principles, Techniques and Tools*", Second Edition, Pearson, 2006.
2. K. Muneeswaran., "*Compiler Design, Oxford University Press*", 2012
3. K.V. N. Sunitha , "*Compiler Construction"* , Pearson, 2013

MCA-20-432 Computer Graphics and Multimedia

Maximum marks: 60 **External:** 48
Time: 3 hours **Internal:** 12
Credit: 3

Course Objectives:

1. *To understand techniques of computer graphics.*
2. *To provide an overview of working principles of graphic devices.*
3. *To provide the working scanning algorithms.*
4. *To understand the applications of computer graphics.*
5. *To provide detail of hidden surface removal techniques.*

Examiner Note: Examiner will be required to set NINE questions in all. Question Number 1 will consist of total 6 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 12 marks. In addition to the compulsory question there will be four units i.e. Unit-I to Unit-IV. Examiner will set two questions from each Unit of the syllabus and each question will carry 9 marks. Student will be required to attempt FIVE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt four more questions selecting One question from each Unit.

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UNIT – I

Computer Graphics: Introduction, applications, Interactive computer graphics, Passive computer graphics.
Devices: Flat panel displays, Three dimensional viewing devices, Stereoscopic and virtual reality system, Joystick, Data glove, Digitizer, Image scanner, Touch panel, Light pen, Voice system.
Graphics Software: Co-ordinate representation, Graphics functions, Software standards, PHIGS workstation.
Drawing Geometry: Point, Line, DDA line drawing algorithm, Bresenham's line drawing algorithm, Properties of circle, Mid point circle drawing algorithm, Pixel addressing & Object geometry.

UNIT – II

Filled area primitive: Scan line polygon fill algorithm, Inside-Outside test, Boundary fill algorithm, Flood fill algorithm.
2-D Transformations: Translation, Rotation, Scaling, Matrix representation & Homogenous coordinate, Composite transformation, General pivot point rotation, General fixed point scaling.
2-D Viewing: View coordinate reference frame, window to viewport coordinate transformation, two dimensional viewing function, line clipping, Cohen-Sutherland line clipping algorithm.

UNIT – III

GUI & Interactive Input: Interactive Picture construction techniques, Basic positioning method, Constraints, Grids, Gravity Fields, Rubber band method, Dragging, Painting and Drawing, Virtual reality environment.
Visible Surface Detection: Classification of visible surface detection algorithm, Depth buffer method, A-Buffer method, Scan line method, Depth sorting method.

UNIT – IV

Illumination, Goraud Shading, Phong Shading, Tweening, Morphing, GKS Permitives, Multimedia Applications, Multimedia Authoring, Languages of Sound, Virtual Reality.

Suggested Readings:

1. Donald Hearn, M. Pauline Baker , *"Computer Graphics C Version"*, Pearson, 2nd Edition.
2. Newman and Sproull, *"Principal of Interactive Computer Graphics"*, Tata Mc Graw Hill,2nd Edition.
3. P.K. Bhatia, "*Computer Graphics*", I.K. Interanational Publisher, 3rd Edition.
4. Zhigang Xiang, *"Computer Graphics"*, Tata Mc Graw Hill, 2006.
5. Foley James, *"Computer Graphics Principles and Practice"*, Pearson Education, 3rd Edition.
6. D.P. Mukherjee, "Fundamentals of Computer Graphics and Multimedia", PHI, 2nd Edition

MCA-20-433 Software Laboratory - XXIV

Maximum marks: 40
Time: 3 hours

External: 32
Internal: 08
Credit: 2

Course Objectives:

1. *To understand techniques of computer graphics.*
2. *To provide an overview of working principles of graphic devices.*
3. *To provide the working scanning algorithms.*
4. *To understand the applications of computer graphics.*
5. *To provide detail of hidden surface removal techniques.*

Examiner Note: Examiner will be required to set Two questions with Internal Choice on the basis of Syllabus for Paper MCA 20-432.

The examinee will be evaluated by External Examiner on basis of:

a)	Practical Record	5
b)	Execution of Programs	15
c)	Viva Voce	12

Instructor Note:

The teacher concerned / instructor will ensure minimum 15 programs / case studies execution during the laboratory work.