Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/ 275 **Date: 03/05/2025.**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

The Head/Co-ordinator/Director
All Concerned Department (Science)
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

1.	M.C.A. Part I
2.	M.C.A. Part I (YCSRD)
3.	M.A. Part II Travel and Tourism

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020 (Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	OE-II & B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR

Yashwantrao Chavan School of Rural Development

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Computer Applications

under
Faculty of Science and Technology

(To be Implemented from Academic Year 2025-26)

Programme Structure

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.C.A. (Science) Part – I (Level-6.0)

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures + Tutorial/ (Hours/ week)	Practical (Hours/ week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-I										
Mandatory	MT-101	4	--	4	70	28	2 ½	30	12	1
	MT-102	4	--	4	70	28	2 ½	30	12	1
	MT-103	2	--	2	35	14	1 ½	15	6	1
	MPR-104	--	8	4	70	28	2 ½	30	12	1
Research Methodology	RM-105	4	--	4	70	28	2 ½	30	12	1
Elective-I	ET-106 / ET-107	4	--	4	70	28	2 ½	30	12	1
Total				22	385			165		
Semester-II										
Mandatory	MT-201	4	--	4	70	28	2 ½	30	12	1
	MT-202	4	--	4	70	28	2 ½	30	12	1
	MT-203	2	--	2	35	14	1 ½	15	6	1
	MPR-204	--	8	4	70	28	2 ½	30	12	1
OJT/FP	OJT-205	--	--	4	70	28	2 ½	30	12	1
Elective - II	ET-206 / ET-207	4	--	4	70	28	2 ½	30	12	1
Total				22	385			165		
Total (Sem I + Sem II)				44						

• MT–Mandatory Theory • MPR–Mandatory Practical • ET–Elective Theory • RM - Research Methodology • OJT/FP- On Job Training/ Field Project	• Total Marks for M.C.A.-I : **1100** • Total Credits for M.C.A. -I (Semester I & II) : 44 • ***Separate passing is mandatory for University and Internal Examinations***
*Evaluation scheme for OJT/FP shall be decided by concerned BOS	
• **Requirement for Entry at Level 6.0: Completion of Level 5.5**	
• **Requirement for Exit after Level 6.0: Students can exit after completion of Level 6.0 with Post Graduate Diploma in Computer Application**	
• **Requirement for Entry at Level 6.5: He/ She have completed MCA Part-I (Level 6.0)**	

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.C.A. (Science) Part – II (Level-6.5)

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures + Tutorial (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-III										
Mandatory	MT-301	4	--	4	70	28	2½	30	12	1
	MT-302	4	--	4	70	28	2½	30	12	1
	MT-303	2	--	2	35	14	1 ½	15	6	1
	MT-304	4	--	4	70	28	2½	30	12	1
	MPR-305	--	8	4	70	28	2 ½	30	12	1
Elective-III	ET-306	4	--	4	70	28	2½	30	12	1
	ET-307									
Total				22	385			165		
Semester-IV										
Research Project	RP-401	--	--	10	200	80	--	100	40	--
Elective-IV	ET-402	4	--	4	70	28	2½	30	12	1
Elective-V	ET-403	4	--	4	70	28	2½	30	12	1
Elective-VI	ET-404	4	--	4	70	28	2½	30	12	1
Total				22	410			190		
Total (Sem III + Sem IV)				44						

• MT–Mandatory Theory • MPR–Mandatory Practical • ET–Elective Theory • RP- Research Project/ Industrial Project	• Total Marks for M.C.A.-II : **1150** • Total Credits for M.C.A.-II (Semester III & IV) : 44 • ***Separate passing is mandatory for University and Internal Examinations***
# Evaluation scheme for Research Project/ Industrial Project shall be decided by concerned BOS	
• **Requirement for Exit after Level 6.5: Students can exit after completion of Level 6.5 with Master of Computer Application**	
• NOTE: As per Approval Process Handbook 2024-27 AICTE, clause 6.11: • ➢ As per the UGC/AICTE Regulation and AICTE (Credit Framework for online learning course through SWAYAM) Regulations, 2016 as amended from time to time, 40% of the courses may be offered in a particular program through SWAYAM/MOOCs platform. ➢ For ET: 402 and ET: 403 and ET: 404: THREE of the available NPTEL, Swayam Courses will be selected in November/December for Registration on the NPTEL Portal. The Swayam Coordinator of the school will select/finalize the suitable courses and will initiate the registration process on the NPTEL portal in November/December of the A.Y. As suggested in NEP-2020	

Course Codes

M.C.A. Semester-I	
Course Code	**Mandatory**
MT-101	Object Oriented Programming using C++ (4 credits)
MT-102	Database Management System (4 credits)
MT-103	Web Technology (2 credits)
MPR-104	Practical-I (4 credits)
RM-105	Research Methodology (4 credits)
Elective-I	
ET-106	Computer Networks (4 credits)
ET-107	Data Warehousing and Data Mining (4 credits)
M.C.A. Semester-II	
	Mandatory
MT-201	Advanced Data Structures (4 credits)
MT-202	Java Programming (Core Java) (4 credits)
MT-203	Advanced Operating System (2 credits)
MPR-204	Practical-II (4 credits)
OJT-205	Internship (4 credits)
	Elective-II
ET-206	Software Engineering (4 credits)
ET-207	Cloud Computing (4 credits)
M.C.A. Semester-III	
	Mandatory
MT-301	Artificial Intelligence (4 credits)
MT-302	Mobile Application Development (4 credits)
MT-303	Cyber Security (2 credits)
MT-304	Advanced Java Programming (4 credits)
MPR-305	Practical-III (4 credits)
	Elective-III
ET-306	Data Science (4 credits)
ET-307	PHP (4 credits)
M.C.A. Semester-IV	
	Mandatory
RP-401	Research Project/ Industry Project (10 credits)
	Elective-IV
ET-402	NPTEL, SWAYAM Course (4 credits)
	Elective-V
ET-403	NPTEL, SWAYAM Course (4 credits)
	Elective-VI
ET-404	NPTEL, SWAYAM Course (4 credits)

Yashwantrao Chavan School of Rural Development, Shivaji University, Kolhapur
Master of Computer Application (MCA)
(Under faculty of Science and Technology)

Program Outcomes

Upon successful completion of the MCA, the student should have met the following Student Learning Outcomes:

1. Nurture knowledgeable and skilled human resources, employable in Information and Communication Technology (ICT) and Information Technology Enable Services (ITES).
2. Ability to identify and formulate research problem.
3. Impart knowledge required for planning, designing and building complex Application Software Systems as well as provide support to automated systems or application.
4. Produce entrepreneurs who can develop customized software solutions for small to large Enterprises.
5. Ability to apply modern IT tools and computational knowledge for developing solutions in context to societal, environmental and sustainable development with ethical and professional responsibility.
6. Ability to function as an effective communicator and team member through essential skills in multidisciplinary projects.
7. Ability to apply on job training experience to solve real world problems with enhanced technical skills.

1. Introduction

This program is offered at Yashwantrao Chavan School of Rural Development, Shivaji University, Kolhapur. The objective of the M.CA. programme is to train the students to meet the challenges of the Software Industry and Research and Development Sector with computational techniques.

2. Duration of the Course:

FULL TIME 2 Years i.e. 4 semesters

3. Medium of Instruction:

The medium of Instruction will be English only.

4. Admission Procedure:

Eligibility conditions and requirements for MCA admissions as per Directorate of Technical Education Rules.

5. Course Structure:

Lectures, Practical, Research/Industrial Projects, On Job Training, Internship, NPTEL, SWAYAM, MOOC courses.

6. Teaching and Practical Scheme

- Each contact session for teaching or practical should be of 60 minutes.
- Minimum 48 contact sessions should be conducted for each subject of 100 Marks.
- Minimum 24 contact session should be conducted for each subject of 50 Marks.
- One Practical Batch should be of 30 students.
- Practical evaluation should be conducted before the commencement of University Examination.

7. Research/Industrial Project: 10 credit courses

In Semester IV students should perform full time Research/Industrial project/ on Job Training/ Field Project. Student has to make a presentation of the work carried out during Research/Industrial Project in front of panel external and internal examiners.

- University examinations: 200 marks, Internal evaluation: 100 marks
- Project viva by university appointed external and internal examiners.
- Internal evaluation will be carried out by internal guide.

8. Research Methodology:

- University examinations: 70 marks, Internal evaluation: 30 marks

9. Examination Pattern and Assessment:

Theory Examination:

1) **For 4 credit course-** University examinations: 70 marks

a) There will be seven (7) questions of 14 Marks each.
b) Question No.1 is compulsory and is of multiple-choice questions. There will be 7 multiple choice question each carries 2 marks.
c) Question No.2 to Question No. 6 should consist 2 sub question each carries 7 marks.
d) Question No. 7 should be a short note, where 4 questions will be given, out of which two questions should be attempted
e) Any four (4) questions to be attempted from question no 2 to 7.

2) **For 2 credit course-** University examinations: 35 marks
   a) There will be five (5) questions. Question No.1 and Question No. 5 are compulsory.
   b) Question No.1 is of multiple-choice questions. There will be 5 multiple choice question each carries 2 marks.
   c) Any two (2) questions to be attempted from Question No. 2 to 4 carries 10 marks each.
   d) Question No. 5 should be a short note, where 2 questions will be given, out of which one questions should be attempted for 5 Marks.

Internal evaluation for 4 credit courses: Internal evaluation: 30 marks

Internal evaluation for 2 credit courses: Internal evaluation: 15 marks

a) A teacher in communication with students and in relevance with the subject assign Research Project to individual student or group of students (maximum 5 students) for Internal examination.
b) The internal marks will be communicated to the University at the end of each semester, but before the semester end examinations. These marks will be considered for the declaration of the results.

Practical Examination:

1) Duration of Practical Examination: 2 ½ Hrs.
2) Nature of Question paper: There will be three questions out of which any two questions to be attempted and each question carries 30 Marks.

3) The final practical examination will be conducted by the university appointed examiners both internal as well as external at the end of semester for each lab course and marks will be submitted to the university by the panel. The pattern of final Practical Examination will be as follows:

1	Coding and Execution of Program	60 Marks
2	Viva-voce	10 Marks
3	Journal	30 Marks
4	Total	100 Marks

The practical examination will be conducted semester wise in order to maintain the relevance of the respective theory course with laboratory course.

On Job Training / Field Project:

For 4 credits: In Semester II students should perform OJT/FP/Internship in vacations after first semester examination or during second semester in offline/virtual mode.

MOOC: In Semester IV **THREE** elective of 4 credits each should be completed in online mode. **THREE** of the available NPTEL, Swayam Courses will be selected in November/December for Registration on the NPTEL Portal, The SWAYAM coordinator will select/finalize the suitable courses (particularly Coding/Programming/Software Skills courses) and initiate the registration process on the NPTEL portal in November/ December of the Academic Year)

10. Standard of Passing:

Internal as well as external examination will be held at the end of semester. The candidate must score 40% marks in each head of internal as well as external Examination.

11. Backlog:

Students should not have more than FOUR (4) backlogs for second year admission.

12. Credit system implementation:

As per the University norms and NEP-2020 Theory Paper / Practical / Research/Industry Project / Internship / OJT Grade Points: Conversion

The marks obtained by a candidate in each Theory Paper / Practical / Research/Industry Project / Internship / OJT and Internal Assessment (out of 100) in any fractions like 70: 30 shall be converted into grades on the basis of the following table.

Marks Range (%)	**Grade Point (GP)**
96 – 100	10
91 – 95	9.5
86 – 90	9
81 – 85	8.5
76 – 80	8
71 – 75	7.5
66 – 70	7
61 – 65	6.5
56 – 60	6
51 – 55	5.5
46 – 50	5
41 – 45	4.5
40	4
Below 40	0

Grading: Shivaji University has introduced a Seven-point grading system as follows:

Grades	CGPA Credit Points
O	8.60 To 10
A+	7.00 To 8.59
A	6.00 To 6.99
B+	5.50 To 5.99
B	4.50 To 5.49
C	4.00 To 4.49
D	0.00 To 3.99

Overall Final Grades	Class		Grade
8.60 To 10	Higher Distinction Level	Extraordinary	O
7.00 To 8.59	Distinction Level	Excellent	A+
6.00 To 6.99	First Class	Very Good	A
5.50 To 5.99	Higher Second Class	Good	B+
4.50 To 5.49	Second Class	Satisfactory	B
4.00 To 4.49	Pass	Fair	C
0.00 To 3.99	Fail	Unsatisfactory	D

13. Board of Paper Setters /Examiners:

For each Semester end examination there will be a board of Paper setters and examiners for every course. While appointing paper setter/examiners, care should be taken to see that there is at least one person specialized in each unit of the course.

14. Clarification of Syllabus:

The syllabus Committee should meet at least once in a year to study and clarify any difficulties from the Institutes. The Workshop on syllabi should be organized at the beginning of every semester on request from Institutes.

15. Revision of Syllabus:

Revision of the syllabus should be considered after every three years.

Equivalence of courses

M. C. A. (Semester I, II, III and IV)

Old Course Code (2024-25)	Equivalent Course Code (2025-26)	Old Course Code (2024-25)	Equivalent Course Code (2025-26)
MMT-101	MT-201	MMT-301	MT-301
MMT-102	MT-102	MMT-302	* No equivalence
MMPR-103	* No equivalence	MMPR-303	* No equivalence
MMT-104	* No equivalence	MMT-304	* No equivalence
RM-107	RM-105	RP-307	* No equivalence
MET-105	ET-106	MET-305	ET-207
MET-106	* No equivalence	MET-306	ET-306
MMT-201	* No equivalence	MMT-401	MT-302
MMT-202	MT-202	MMT-402	* No equivalence
MMPR-203	* No equivalence	MMPR-403	* No equivalence
MMT-204	MT-103	RP-406	* No equivalence
OJT-207	OJT-205	MET-404	* No equivalence
MET-205	* No equivalence	MET-405	* No equivalence
MET-206	ET-206		

* Three more chances be given to the student.

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Object Oriented Programming using C++

Course Code: MT-101 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1) Understand and use the basic programming constructs of C++.
2) Manipulate various C++ datatypes, such as arrays, strings, and pointers.
3) Manage memory appropriately using proper allocation/deallocation procedures.
4) Write small-scale C++ programs using the above skills.

Unit-I **[15 Hrs.]**

Fundamentals:

Object-Oriented Programming (OOP): Need, Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, C++ as object-oriented programming language.

Object-Oriented Programming using C++: C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.

Functions: Function, function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function, static functions, function overloading, friend functions.

OOP Concepts: The 'Struct' keyword, Functions within structures, Data encapsulation and classes, 'this' pointer, Constructors and Destructors, Overloading constructors, Copy Constructor, Assignment and Copy Initialization, Methods and their return values, Objects and Memory requirements, Static Class members, friend class.

Unit-II **[20 Hrs.]**

Polymorphism and Inheritance:

Base Class and derived Class, access specifiers, Constructor and Destructor in Derived Class, Virtual destructor, Protected members, Overriding member functions, Public and Private Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Composition, Nested Classes.

Operator Overloading: concept of overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Keywords 'explicit' and 'mutable'. Pointers- indirect ion Operators, Memory Management: new and delete, Pointers to Objects. Virtual

Functions: concept, pure virtual functions and abstract classes, arrays in polymorphism, late binding, Function pointers, Debugging Pointers, Dynamic Pointers, smart pointers.

Unit-III **[10 Hrs.]**

Files and Streams:

Data hierarchy, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output

Unit-IV **[15 Hrs.]**

Templates and Exception Handling:

Templates: Function templates, Template specialization, Class templates, Non-type parameters for templates, template, and inheritance, The typename and export keywords. Exception Handling: Other error handling techniques, Exceptions, Exception handling in C++, rethrowing an exception, exception specifications, processing unexpected exceptions, stack unwinding, exception handling in constructors, destructors.

Standard Template Library (STL):

Introduction to STL: Containers, algorithms, adaptors, and iterators, Containers: Sequence container and associative containers, Adaptors: container adapters, iterator adaptors, Algorithms: basic searching and sorting algorithms, min-max algorithm, set operations, Iterators: input, output, forward, bidirectional and random access.

References:

1. Robert Lafore, Object-Oriented Programming in C++, fourth edition, Sams Publishing, ISBN:0672323087.

2. Bjarne Stroustrup, The C++ Programming language, Third edition, Pearson Education ISBN 0-201-88954-4.

3. Deitel, C++ How to Program, 7th Edition, Pearson Education, ISBN-10: 0-13- 611726-0 ISBN-13: 978-0-13-611726-1.

4. Herbert Schildt, C++ The complete reference, Fifth Edition, McGraw HillProfessional, ISBN-10: 0071634800 ISBN-13: 978-0071634809.

5. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo(2013), C++ Primer, Fifth Edition, Addison-Wesley, 2013, ISBN-13: 978-0-321-71411-4, ISBN-10: 0-321-71411-3

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Database Management System

Course Code: MT-102 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1) Learn and practice data modelling using the entity-relationship and developing database designs.
2) Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3) Apply normalization techniques to normalize the database
4) Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

UNIT 1 (15 HOURS)

Basics Of DBMS: Database Concept, Characteristics and architecture of DBMS, Database users, 3-tier architecture of DBMS-its advantages over 2-tier, Introduction of Parallel, Distributed Databases, Mobile databases and Cloud databases. Data independence. Physical data organization, Indexing-introduction and types of indexing.

UNIT 2 (15 HOURS)

Introduction to RDBMS:-Entity introduction, characteristics, Comparison between DBMS, RDBMS, Generalization and Aggregation Normalization- Functional dependency, types of normalization(1NF,2NF,3NF,BCNF),Data constraint- primary key, foreign key, unique key, null, not null, default key etc. Relational Algebra Concepts; introduction, Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations : JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra;

UNIT 3 (15 HOURS)

SQL: Introduction to SQL, Features of SQL, Basic data types, SQL statements/commands, Set operations in SQL, order by and group by clause, like between, in, like, create index , view and join command Nested queries, GRANT and REVOKE, Commit, Rollback, Save point. Join concept: Simple, Equi, non-equi, Self, Outer join. View. Introduction to PL /SQL: Introduction, Difference between SQL AND PL/SQL, Block definition structure and Data types, Block Functions, cursor, trigger, procedures, exception handling. No SQL Database - Introduction, Need& Advantages ,Types of No SQL Database , No SQL database vs RDBMS

UNIT 4 **(15 HOURS)**

Concurrency Control and Transaction Management: Transaction processing and Concurrency-Concept of transaction processing, ACID properties, States of transaction , Serializability, Concurrency control, schemes, Locking techniques , Timestamp based protocols , Granularity of data items ,Deadlocks. Database recovery and Backup.

References:

1. Introduction to database systems C. J. Date Pearsons Education 8th
2. Database system concept Korth, Silberschatz and Sudarshan MGH 5th
3. Fundamentals of Database Systems Elmasri Navathe PearsonEducation5th
4. SQL /PL SQL For Oracle 11G BlackBook Dr.Deshpande WileyDreamtech2012
5. ORACLE PL/SQL Programming Scott Ulman TMH 9th
6. SQL, PL/SQL the programming language of Oracle Ivan Bayross BPB 4th
7. Advance Database Management System hakrabharati/DasguptaWileyDreamtech2011
8. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence Martin Fowler
9. Database Management systems Ramakrishnan&Gehrke, McGraw-Hill,3rd Ed.

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Web Technology

Course Code: MT-103 Total Credits: 02

Internal Marks: 15 External Marks: 35 Theory: 02 hours/week

Course Outcomes:

1) Design the web applications/sites.
2) Apply dynamic paging using AngularJS/JSON/JQurey..
3) Use Javascript/Node.JS to make design and scripting.
4) To apply web programming concepts for real world problem solving.

Unit-I **[15 Hrs.]**

HTML and CSS: Introduction to HTML Introduction to CSS, Introduction to HTML5

JavaScript: Introduction to JavaScript, Variable, statements, Operators, Comments, constructs, Functions, expressions, JavaScript console, Scope, Events, Strings, String Methods, Numbers, Number Methods, Dates, Date Formats, Date Methods, Arrays, Loops Object Prototypes, Object Oriented Programming, JavaScript Validations, Security in Java Script.

Bootstrap :Introduction to Responsive Web Design, Overview of Bootstrap, Need to use Bootstrap, Bootstrap Grid System, Grid Classes, Basic Structure of a Bootstrap Grid, Typography, Tables, Images, Jumbotron, Wells, Alerts, Buttons, Button Groups, Badges/Labels, Progress Bars, Pagination, List Groups, Panels, Dropdowns, Collapse, Tabs/Pills, Navbar, Forms, Inputs, Bootstrap Grids, Grid System, Stacked/Horizontal, Bootstrap Themes, Templates

AngularJS: Introduction to AngularJS, Structuring AngularJS application, MVC in AngularJS, AngularJS routing, AngularJS services

Unit-II **[15 Hrs.]**

JQuery: Basics of jQuery, jquery selection and events, jQuery Effects, jquery traversal and manipulation, Data attributes and templates, jQuery Plugins, JQuery / Google Web Toolkit

Node.js: Node.js: Introduction to Node.js, Node modules, Developing node.js web application, Event-driven I/O server-side JavaScript, Express: Introduction to Express, First Express Application, Application, Request and Response Objects, Implementing MVC Pattern, Express application configuration, Rendering Views.

JSON: Introduction, Need of JSON, JSON Syntax Rules, JSON Data - a Name and a Value, JSON Objects, JSON Arrays, JSON Uses JavaScript Syntax, JSON Files, JSON & Security Concerns, Cross Site Request Forgery (CSRF), Injection Attacks ,Responsive Web Design

References:

1) HTML5 Programmer's Reference. Reid, J. (2015). Apress.

2) Bootstrap: Responsive Web Development. Spurlock, J. (2013). OReilly Media.

3) Professional AngularJS. Karpov, V., Netto, D. (2015). Wiley.

4) Web Development with JQuery. York, R. (2015). Wiley.

5) Professional Node.js: Building Javascript Based Scalable Software. Teixeira, P. (2012). Wiley.

6) Beginning JSON. Smith, B. (2015). Apress.

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Practical-I

Course Code: MPR-104 Total Credits: 04

Internal Marks: 30 External Marks: 70 Practical: 08 hours/week

Course Outcomes:

1) Create and maintain tables using PL/SQL, Populate and query a database using SQL DML/DDL commands
2) Programming PL/SQL including stored procedures, stored functions, cursors, triggers.
3) Develop Web site/App and Web site dynamic using AngularJS/JSON/jQuery.
4) Use Bootstrap and JavaScript to make design and scripting.

Lab work is based on Database Management System and Web Technology. This laboratory course should consist of 15 to 20 programming exercises with focus on covering the hands-on aspects covered in theory course.

Suggested Practical Assignments DBMS:

1) Creating database tables and using data types.

2) Create table, modify table, Drop table

3) Practical Based on Data Manipulation. Adding/Modify/Delete data using Insert/ Update/ Delete

4) Practical Based on Implementing the Constraints. NULL and NOT NULL, Primary Key Constraint, Foreign Key Constraint Unique Constraint, Check Constraint, Default Constraint

5) Practical for Retrieving Data Using following clauses. Simple select clause Accessing specific data with Where Clause Ordered By/ Distinct/Group By Clause

6) Practical Based on Aggregate Functions. AVG, COUNT, MAX, MIN, SUM, CUBE

7) Practical Based on implementing all String functions.

8) Practical Based on implementing Date and Time Functions.

9) Practical Based on implementing use of UNION, INTERSECTION, SET DIFFERENCE.

10) Implement Nested Queries & all types of JOIN operation.

11) Practical Based on performing different operations on a view.

12) Practical Based on implementing use of Procedures.

13) Practical Based on implementing use of Triggers.

14) Practical Based on implementing Cursor.

15) Demonstrate Database connectivity with front end tools like –VB.NET, C#.NET, JAVA etc

16) Practical based on creating Data Reports.

17) Design entity relationship models for a business problem and develop a normalized database structure.

Suggested Practical Assignments Web Technology:

1) Design a website with HTML Form.
2) Design a website using CSS 2.1 and CSS3.
3) Design a website with HTML5.
4) Design a dynamic web form with validations using JavaScript.
5) Design a website with Bootstrap.
6) Design a dynamic website with AngularJS.
7) Demonstrate the use of jQuery in a website.
8) Demonstrate the use of Node.js in a website.
9) Demonstrate the use of JSON in a website.
10) Design a dynamic website using demonstrating the web technologies (HTML, JavaScript, Bootstrap, Angular JS, JQuery).

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Research Methodology

Course Code: RM-105 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1) Understand the fundamental concepts and principles of research methodology in computer science
2) Identify and select appropriate research methodologies based on the research problem
3) Formulate research questions and hypotheses in the context of computer science research
4) Develop critical thinking and problem-solving skills required for computer science research

Unit–I **(15 Hours)**

Meaning of Research, objectives of Research, motivation in Research, Types of Research, Significance of Research, Research and Scientific Method, Criteria of good Research, Current trends in Research, Survey research, Data collection techniques, problems encountered by Researchers in Data Collection, Statistical Data analysis and interpretation, Triangulation in research design, Sequential and concurrent mixed methods design, Sampling Techniques in Computer Science Research.

Unit -II **(15 Hours)**

Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline, Use of tools / techniques for Research: methods to search required information effectively, study and implementation of various databases like Google scholar, Scopus index, web of science, research gate etc. Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office.

Unit -III **(15 Hours)**

Nature of Intellectual properties like patents, trade and copyright, Common rules of IPR practice, types and features of IPR agreement, Population and sample selection, Probability and nonprobability sampling, Sample size determination, Observation methods, Questionnaire design, Descriptive statistics, Inferential statistics, Qualitative data analysis techniques (thematic analysis, content analysis), Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Impact factor of Journals, H-index of the researcher, various citation styles, Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Software for detection of Plagiarism

Unit -IV **(15 Hours)**

Research reports: Writing preliminaries, main body of research, references and bibliography; Meaning and importance of workshop, seminar, conference, symposium etc. in research, Report format and style. Review of related literature its implications at various stages of research, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports. Writing a research proposal.

References

1. Research Methodology in Computer Science by Ryhan Ebad, Centrum Press.
2. Research Methodology by C.R. Kothari
3. Research Methods by Rashmi Agrawal
4. Qualitative Research for Education by Bogdan & Biklen
5. Methods of Educational Research by Max Engelhart
6. Business Research Methods by Alan Bryman & Emma Bell, Oxford University Press

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Computer Networks

Course Code: ET-106 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1) Analyze the basics of data communications and network architecture.
2) Analyze functions of each layer of a computer network.
3) Evaluate essential features of specific protocols in the common protocol suite.
4) Analyze the methodology and the rationale behind addressing, routing, and congestion control.
5) Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

UNIT-I (15 Hours)

Data communication-analog and digital signal transmission, Data transmission-serial and parallel transmission, communication and transmission modes (synchronous, asynchronous), error control(forward, backward) error detection(parity, block sum check, CRC), transmission media (twisted pair, coaxial cable, optical fibers), unguided transmission media(radio waves, microwaves, infrared), classification of computer network- geographical spread (LAN,WAN, MAN), topology- (bus, star, ring, mesh, tree), ownership (private, public, VAN), switching circuit, packet, message and routing, multiplexing-FDM,TDM, concentrator, components of computer networks-files server, workstation, network interface unit, transmission media, hub, repeater, bridge, router, gateway, mode. Case study- Prepare/ present report on network components used in any selected organization/Institute/Company.

UNIT-II (15 Hours)

Data Link Layer: Error detection and control code- Error Control -Hamming Code and CRC Flow Control -Stop and Wait protocol, sliding window protocol, Random Access Protocols - ALOHA – pure and slotted. Network Layer: Store-and-forward packet switching, Services Provided to the Transport Layer, Implementation of Connectionless and Connection Oriented Service, concept of routing, optimality principle, routing algorithms-shortest path, distance vector, link state, hierarchical, broadcast, multicasting. Congestion control & congestion control algorithm.

UNIT-III (15 Hours)

Transport Layer- Introduction, transport service primitives, multiplexing, UDP, TCP. Application Layer-Domain name system (DNS), Telnet, File transfer protocol (FTP), Simple mail transport protocol (SMTP), Hyper text transfer protocol (HTTP), Network file system (NFS).

UNIT-IV **(15 Hours)**

Network Security- Introduction, concept of cryptography, authentication protocols, firewall, virtual private networks (VPN), wireless security, email security, web security- SSL. Case Study – Implementation of LAN, Configuration of various connecting devices.

References:

1. Computer Networks Andrew Tanenbaum Pearson Education
2. Computer Networks Fundamentals and applications, R S Rajesh, K S Easwara kumar, R Bala subramanian, VIKAS Publishing House Pvt. Ltd.
3. Data Communication and Networks James Irvin, David Harle Wiley
4. Computer Networks protocols, Standards and Interface Black C. Prentice Hall of India
5. Computer Communication Networks William Stalling Prentice Hall of India

M. C. A. Science (Part I) (Level-6.0) (Semester I) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Data Warehousing and Data Mining

Course Code: ET-107 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1) Analyse data warehouse characteristics and plan warehouse data and Illustrate trends towards data warehousing and data mining.
2) Understand the importance of data mining in emerging world and business value of data warehousing and data mining.
3) Understand data mining principles and techniques: Introduce DM as a cutting-edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modelling, and identifying new trends and behaviours.
4) Describing and demonstrating basic data mining algorithms, methods, and tools

Unit I **(15 hrs)**

Introduction: Data Warehouse and OLAP Technology: Data warehouse concept, A multidimensional data model, data warehouse architecture, From data warehousing to data mining. Data Preprocessing: Descriptive data summarization, data cleaning, data integration and transformation, data reduction

Unit II **(15 hrs)**

Introduction: Data mining concepts, Data mining functionalities, classification of data mining systems, Integration of data mining system with a database or data warehouse system, major issues in data mining. Mining frequent patterns, Associations and Correlations: Basic concepts and road map, efficient and scalable frequent itemset mining methods.

Unit III **(15 hrs)**

Classification and Prediction: Concept of classification and prediction, issues regarding classification and prediction, classification by decision tree induction, Bayesian classification, rule-based classification, classification by backpropagation, support vector machines, lazy learners, other classification methods.

Unit IV **(15 hrs)**

Cluster analysis : Concept of cluster analysis, types of data in cluster analysis, a categories of major clustering methods, partitioning methods, hierarchical methods, data mining applications.Web Mining: Introduction, Web content Mining, Web structure Mining, Web Usage Mining.

Reference Books:

1. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson education.
2. Data Mining concepts and techniques --- Jiawei Han and Micheline Kamber , Elsevier
3. Data Mining: Introductory and Advanced Topics - Margaret H. Dunham, Pearson education
4. Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank
5. Data Warehousing in real world – Sam Anahory, dennis murray
6. Data Mining Methods --- Rajan Chattamvelli
7. Data Mining Techniques – Gordon S. Linoff and Michael J. A. Berry

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Advanced Data Structures

Course Code: MT-201 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1. Analyze the asymptotic performance of algorithms.
2. Compare algorithms based on time & space complexity.
3. To learn how data structure concepts are useful in problem solving.
4. To implement different ways of data structures such as stacks, linked lists and trees

UNIT -1 **(15 Hours)**

Algorithm Analysis: Introduction to algorithms, analyzing and designing algorithms, Growth functions, asymptotic notations, Recursive algorithm complexity, solving recurrences: Substitution method, recursion tree method, master method. Searching: Binary search, Hashing: Hashing, Hash tables, Hash functions, collision resolution techniques. Sorting: Quick sort, Counting sort, Radix sort, Merge sort, Heap sort, Insertion sort and selection sort.

UNIT- II **(15 Hours)**

Linear Data Structures: Linked Lists: Linked Representation in memory, traversing and searching a linked list, insertion and deletion from a linked list, singly, doubly and circular linked list. Stack: Definition, array and linked representation of stacks, arithmetic expression: polish notation, application of stack, Queue: Definition, array and linked representation of Queue, priority queues.

UNIT- III **(15 Hours)**

Non-Linear Data Structures: Trees, General tree, Binary tree, binary search tree, operations on binary search tree, AVL Trees, Single rotation, Double rotation, Red-Black Trees, B-Trees: Definition of B-trees, Basic operations on B-trees, deleting a key from a B-tree. Graphs: Representations of graph, Traversing Graphs, Breadth-first search, Depth-First Search, topological sort, Minimum Spanning trees, Single source hortest path, All pairs shortest path.

UNIT- IV **(15 Hours)**

Algorithm design approaches: Greedy Algorithm: General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal’s algorithm, Prim’s algorithm), Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code. Backtracking: Introduction, N

Queen Problem, Subset Sum, Hamiltonian Cycle, Branch and Bound – Introduction, 0/1 Knapsack, Travelling Salesman problem Dynamic programming: Introduction, Tabulation, memorization, Optimal Substructure Property in Dynamic Programming

References:

1) Introduction to algorithms, Third Edition. by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI
2) Fundamentals of Computer Algorithms, Second edition. By Ellis Horowitz, Sartaj Sahani, Sanguthevar Rajasekaran, University Press.
3) Data structures and algorithm analysis in C, Second edition. By Mark Allen weiss
4) Fundamental algorithms by Donald E. Knuth, Pearson Education.
5) Data and file structure by A. Tanenbaum by PHI

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Java Programming (Core Java)

Course Code: MT-202 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1. To become comfortable with concepts such as Classes, Objects, Inheritance, Polymorphism and Interfaces.
2. Develop Java client/server applications.
3. Understand distributed applications using RMI.
4. Understand Spring and Spring Boot Framework.

Unit -I **(15 Hours)**

Introduction: Architecture and its components, Introduction to java programming environment: Java Class File, Java Runtime Environment, The Java Virtual Machine(JVM), JVM Components, The Java API, java platform, java development kit , java compiler, java interpreter, Understanding Class path, Features of Java, Byte Code, Control Flow Statements: The If…Else If… Else Statement, the Switch…Case Statement , Iterations: The While Loop, The Do … While Loop, The For Loop, The For each Loop, Labelled Statements, The Break And Continue Statements.

Unit -II **(15 Hours)**

OOP in Java ,Objects and classes, Inheritance, Polymorphism , Interfaces, inner classes, Constructor, Garbage collector , Method Overloading Method Overriding, this key word, super keyword, Packages., data types in java primitive data type and non primitive data type. Introduction: Comments, Types of comments. Classes: Types of Classes, Scope Rules, Access Modifier. Introduction to Java Utility classes and collection classes Date, DateFormat and Gregorian calendar classes.java package, A Simple Java Program, Object Creation, Using Java.lang. Object class in program, programs using inheritance, using packages in java program.

Unit -III **(15 Hours)**

Java Servlets: Servlet basics, servlet life cycle , Generic and HTTP servlets, The Servlet API, javax.servlet and javax.servlet.http package, session tracking using session and cookies, web deployment descriptor, web.xml. Remote Method Invocation–Introduction, architecture, defining remote objects, creating stubs and skeleton, object serialization, dynamically loaded classes, RMI activation, registering remote objects, marshaled objects. Java Server Pages (JSP):

Introduction to JSP tags and directive, Request String, User Sessions, Cookies, Session objects.

Unit-IV **(15 Hours)**

Java Database Connectivity, JDBC overview, Architecture, Types of JDBC Drivers, Driver Manager class, database connection statements, Resultset, transaction, Metadata and Aggregate functions , callable statements, Connection to various back ends. Spring and Hibernate: Spring API libraries, Introduction to Spring Boot, Features of Spring Boot Spring Boot Architecture.

References

1. JDBC, Servlet and JSP, Black Book, Santosh Kumar K. Dremtech publication
2. Java 2 Complete Reference - (Tata McGraw Hill)
3. Spring and Hibernate, Santosh Kumar K. Mc.Graw Hill Education
4. Developing Java Servlets James Goodwill, Techmedia Pub.
5. Java 2 Black Book –(DreamTech)

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Advanced Operating System

Course Code: MT-203 Total Credits: 02

Internal Marks: 15 External Marks: 35 Theory: 02 hours/week

Course Outcomes:

1. To study the characteristics of OS for Multiprocessor and Multicomputer
2. To learn the issues related to designing OS
3. To learn the latest trends in building Mobile OS
4. To study, learn, and understand the main concepts of advanced operating systems

Unit-I **(15 Hours)**

Overview of operating system design principles, Historical perspective and evolution of operating systems, Challenges in modern operating systems, Basics of process scheduling, Scheduling algorithms: FCFS, SJF, Round Robin, Priority Scheduling, Multilevel feedback queues and lottery scheduling, Real-time scheduling algorithms, Address spaces and memory hierarchy, Paging and segmentation, Virtual memory management, Page replacement algorithms, Memory allocation and de-allocation. Multiprocessor Operating Systems: System Architectures- Structures of OS, OS design issues,
Process synchronization, Process Scheduling and Allocation- memory management,

Unit-II **(15 Hours)**

Distributed Operating Systems: System Architectures, Design issues, Communication models, clock synchronization, mutual exclusion, election algorithms, Distributed Deadlock detection, Distributed scheduling - Distributed shared memory, Distributed File system, Multimedia file systems, File placement, Caching. File system design principles, File organization and access methods, File system implementation techniques, Directory structures and file metadata, File system reliability and recovery, Introduction to distributed systems, Networked file systems, Distributed process management, Distributed synchronization and consistency, Distributed fault tolerance and recovery, Threat models and security principles, User authentication and access control, Secure communication and encryption, Security vulnerabilities and countermeasures, Intrusion detection and prevention

References

1. Advanced Concepts in Operating Systems, by M Singhal and NG Shivaratri, Tata McGraw Hill Inc
2. Distributed Operating Systems by A S Tanenbaum, Pearson Education Asia
3. Operating Systems: A Concept-Based Approach by D M Dhamdhere
4. Operating Systems: Internals and Design Principles by William Stallings

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Practical-II

Course Code: MPR-204 Total Credits: 02

Internal Marks: 15 External Marks: 35 Practical: 04 hours/week

Course Outcomes:

1) Apply practical knowledge on the applications of data structures.
2) To apply data structure programming concepts for real world problem solving.
3) Apply practical knowledge on the applications using Java.
4) To apply java programming concepts for real world problem solving.

Lab work is based on Advanced data structure and Java Programming. This laboratory course should consist of 15 to 20 programming exercises with focus on covering the hands-on aspects covered in theory course.

Suggested Practical Assignments Advanced Data Structures:

1) **Implementation of programs based on the following**
   Arrays, Multidimensional Arrays, Matrices, Stacks, Polish Notation, Queues, Deques, Linear Linked List, Circular Linked List, Doubly Linked List, Polynomial Addition/Subtraction
2) **Implementation of programs based on Trees**
   Binary Search Tree, In-order, Pre-order and Post-order Traversals, Heap Tree
3) **Implementation of programs based on Graphs**
   Depth First Traversal, Breadth First Traversal, Obtaining Shortest Path (Dijkstra and Floyd-Warshall), Minimum spanning tree (Kruskal and Prim)
4) **Implementation of programs for Hash Table, Searching and Sorting techniques**
   Hash Table, Linear and Binary Search (using array), Bubble sort, Selection sort, Insertion sort, Radix sort, Quick sort, Merge sort, Heap sort

Suggested Practical Assignments java programming:

1. Write a program that demonstrates program structure of java with use of arithmetical and logical implementation.
2. Write a program that demonstrates string operations using String and StringBuffer class.
3. Write a program to demonstrate inner class and static fields.
4. Write a program that demonstrates inheritance, polymorphism.
5. Write a program that demonstrates 2D shapes on frames.
6. Write a program that demonstrates color and fonts.
7. Write a program to illustrate the use of various swing components.
8. Write a program that demonstrates use of dialog box and menus.
9. Write a program that demonstrates event handling for various types of events.
10. Write a program to illustrate multithreading.
11. Write a program to illustrate exception handling.
12. Write a program to demonstrate the use of File class.
13. Write a program that demonstrates JDBC on application.
14. Write a program that demonstrate package creation and use in program.

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Internship

Course Code: OJT-205 Total Credits: 04

Internal Marks: 30 External Marks: 70

Course Outcomes:

1. Gain industrial experience.
2. Learn office ethics.
3. Learn to work in team.

In Semester II students should perform OJT/FP/Internship in vacations after first semester examination or during second semester in offline/virtual mode.

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Software Engineering

Course Code: ET-206 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1. Students will get foundation of software engineering, various process models and can apply the new models in development process.
2. Students will have effective communication and interaction skills for requirement engineering tasks.
3. Students can apply design principles for various types of software and designing object oriented software using UML tools.
4. Students can implement testing strategies thoroughly using testing tools.
5. Students will understand the need of lifelong learning and adapt to new software engineering concepts.

UNIT-I (15 Hours)

Introduction to Software Engineering: Software definition, characteristics, software application domains, unique nature of web apps, seven principles of software engineering, software development process, Waterfall Model, prototyping, spiral model, Concurrent Models, The Formal Methods Model, 12 Principles of Agility, Extreme Programming (XP), Scrum process flow, Selection of Software Process models.

UNIT -II (15 Hours)

Requirements Engineering and Design Concepts: Seven tasks of requirement engineering, Eliciting Requirements, Types of requirement, fundamental problem in defining requirements, SRS template. Translating the requirement model into the design model, software design concepts- abstraction, architecture, pattern, separation of concerns, modularity, information hiding, functional independence-cohesion, coupling, refinement, aspects, refactoring.

UNIT -III (15 Hours)

Introduction to UML: The design model: Developing use cases, Relationships, class diagrams, associations, generalizations, object diagram, Dynamic modeling – State diagrams, Sequence diagrams, Collaboration diagrams, Activity diagrams etc. Logical and physical architecture – Component diagram, Deployment diagrams etc. Case Studies: Courseware management system, ATM, Airline reservation System

UNIT-IV **(15 Hours)**

Introduction to Testing: A Strategic Approach to Software Testing, Strategic Issues, Unit testing, Integration testing, Validation Testing, System Testing, Black box testing and white box testing, The Art of Debugging. Testing web applications- testing strategy, testing process, content testing, user interface testing, navigation testing, configuration testing, security testing, performance testing. Study of software testing tool.

References:

1. Software Engineering by Roger Pressman. 7th edition.
2. Software Engineering for students: A Programming Approach by Douglas Bell, Pearson publication.
3. Software Engineering Sommer ville 8th edition.
4. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson Addison Wesley 2005.
5. UML A Beginners Guide Jason T. Roff McGraw Hill Professional.
6. Learning UML 2. 0 Kim Hamilton, Russ Miles O'Reilly Media 2006.
7. Software Quality Engineering by Jeff Tian.
8. Software Testing And Quality Assurance Theory And Practice By Kshirasagar Naik, Priyadarshi Tripathy
9. The art of software testing by GJ Myers, Wiley
10. Software Testing: Principles and Practices by Srinivasan D and Gopalswamy R, Pearson Ed, 2006
11. Software Testing Foundations, Andreas Spillner, Tilo Linz, Hans Schaefer, Shoff Publishers and Distributors

M. C. A. Science (Part I) (Level-6.0) (Semester II) (NEP-2020)

(Introduced from Academic Year 2025-26)

Title of Course: Cloud Computing

Course Code: ET-207 Total Credits: 04

Internal Marks: 30 External Marks: 70 Theory: 04 hours/week

Course Outcomes:

1. Acquire knowledge of cloud computing and its usage.
2. Understand components and operations of cloud computing system.
3. Understand the concept of Virtualization and design of cloud Services
4. Enhance skills for data management, storage and operations in cloud computing system
5. Study recent trends in cloud computing.

UNIT I (15 HOURS)

Fundamentals of cloud computing Evolution of cloud computing, characteristics of cloud computing, need of cloud computing, Components of cloud computing, cloud computing architecture, client server architecture, grid computing environment, Cloud computing vs. Cluster computing, types of cloud, major players in cloud computing, advantages and challenges of cloud computing.

UNIT II (15 HOURS)

Virtualization architecture and its needs, benefits and challenges, types of virtualization, Levels of Virtualization Implementation, virtualization of CPU, Memory and I/O devices, server virtualization, virtualization design requirements, virtualization structure, open source virtualization technology, Pros and cons of virtualization. Hypervisor, Virtual Machine Types, load balancing, Examples of cloud services- Microsoft azure, Google cloud, VMware, Amazon EC2.

UNIT III (15 HOURS)

Cloud services-IaaS, SaaS, PaaS, DaaS, MaaS, CaaS, DBaas, Implementation and Architecture of Eucalyptus, Nimbus &Open Nebula, cloud development techniques, cloud based storage, cloud backup, Cloud security - Cloud Security Challenges and Risks, disaster recovery, data integration, data transformation, data migration, challenges with data security

UNIT IV (15 HOURS)

Recent trends in cloud computing Cloud standards, service oriented architecture (SOA) for cloud application, mobile cloud computing its application, architecture and working. MongoDB, MapReduce implementations for the Cloud.Multi- cloud approach, Role of AI in Cloud Computing, Hybrid and on- premise cloud. IoT cloud platforms.

References:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, 2012, 1st Edition, Morgan Kaufmann Publishers.
2. Barrie Sosinsky, “Cloud Computing Bible, “ Wiley India Pvt. Ltd. 2012
3. Prasant Kumar Pattnaiket.al., Fundamentals of Cloud Computing, Vikas Publication House Pvt. Ltd.,first Edition 2015
4. Dr. U.S. Pandey, Dr. KavitaChoudhary, “Cloud Compting”, S. chand, 2014
5. Imad M. Abbadi, “cloud Management Security”, Wiley,2019
6. RajkumarBuyya,JamesBroberg, Andrzej Goscinski, “cloud Computing Principles and Paradigms”, Wiley,2015
7. Dr. Kumar Saurabh, “Cloud Computing”, second Edition, wiley,2012
8. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing “A Practical Approach” McGraw-Hill.
9. Kailash Jauaswal, JagannathKallakurchi, Donald J. Houde, Dr. Deven Shah, “Cloud Computing”, Black Book, Dreamtech , 2014