Estd. 1962
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NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/288 **Date: 05/08/2026**

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

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

Subject: Regarding revised syllabi of M.Sc. & MCA Part-I (Sem I & II) 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 syllabi, nature of question paper of M.Sc. & MCA Part-I (Sem I & II) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

M.Sc. & MCA Part-I (Sem. I & II) as per NEP-2020 (2.0)	
1.	M.C.A. Part I
2.	M. Sc. Computer Science Part I

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. 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

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	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
		11	Distance and Online Education

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962
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Structure and Syllabus in Accordance with National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Computer Science)

(Under Faculty of Science and Technology)

PART-I SEMESTER - I & II

(Revised syllabus to be implemented from Academic year 2026-27)

1. Preamble

M.Sc. (Computer Science) aims to provide technology-oriented students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society. The syllabus is about developing skills to learn new technology, grasping the concepts and issues behind its use and the use of computers. The courses offered cover the recent trends and techniques in the IT industry and try to make Industry ready students. This programme also motivates students for research in the form of research projects included as part of curriculum.

2. Duration

The M.Sc. programme will be a full-time TWO years i.e. 4 semesters. Pattern of examination will be Semester System.

3. Eligibility for Admission

- ✓ B.Sc. Computer Science (Entire/ optional) / B.Sc. IT/ BCA, B.Sc. Mathematics, B.Sc. Statistics, B.Sc. Electronics, B.Sc. Animation, B.Sc. Physics, B.Sc. Chemistry/ BSc. Microbiology.
- ✓ Admission through University Entrance exam only.
- ✓ Only entrance marks should be considered for admission process.
- ✓ Reservation of Seats as per rules of Government of Maharashtra

4. Medium of Instruction

The medium of Instruction will be English only.

5. Programme Structure

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Computer 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										
Major Mandatory	MMT-101	4	--	4	60	24	2	40	16	
	MMT-102	4	--	4	60	24	2	40	16	
	MMPR-103	--	8	4	60	24	2	40	16	
	MMT-104	2	--	2	30	12	2	20	8	
Major Elective	MET-105	4	--	4	60	24	2	40	16	
	MET-106									
Research Methodology	RM-107	4	--	4	60	24	2	40	16	
Total				22	330			220		
Semester-II										
Major Mandatory	MMT-201	4	--	4	60	24	2	40	16	
	MMT-202	4	--	4	60	24	2	40	16	
	MMPR -203	--	8	4	60	24	2	40	16	
	MMT-204	2	--	2	30	12	2	20	8	
Major Elective	MET-205	4	--	4	60	24	2	40	16	
	MET-206									
OJT/FP	OJT-207	--	--	4	60	24	2	40	16	
Total				22	330			220		
Total (Sem I + Sem II)				44						

<table>
<tr><td>• MMT–Major Mandatory Theory
• MMPR–Major Mandatory Practical
• MET–Major Elective Theory
• MEPR–Major Elective Practical
• RM - Research Methodology
• OJT/FP- On Job Training/ Field Project</td><td>• Total Marks for M.Sc.-I : 1100
• Total Credits for M.Sc.-I (Semester I & II) : 44
• Separate passing is mandatory for University and Internal Examinations</td></tr>
<tr><td colspan="2">*Evaluation scheme for OJT/FP shall be decided by concerned BOS</td></tr>
<tr><td colspan="2">• Requirement for Entry at Level 6.0: Completion of Level 5.5</td></tr>
<tr><td colspan="2">• Requirement for Exit after Level 6.0:
Students can exit after completion of Level 6.0 with Post Graduate Diploma in Computer Science</td></tr>
<tr><td colspan="2">• Requirement for Entry at Level 6.5: He/ She have completed MSc Part-I (Level 6.0)</td></tr>
</table>

6. Programme Educational Objectives (PEO)

1. Apply and continuously acquire knowledge, theoretical and applied, related to core areas of computer science
2. Demonstrate the ability to work effectively as a team member and/or leader in an ever-changing professional environment
3. Work productively as computer professionals (in traditional careers, graduate school, or academia) by demonstrating effective use of oral and written communication, working competently as a member of a team unit, adhering to ethical standards in the profession.

7. Program Outcomes (PO's)

1. Communicate computer science concepts, designs, and solutions effectively and professionally
2. Apply knowledge of computing to produce effective designs and solutions for specific problems
3. Identify, analyze, and synthesize scholarly literature relating to the field of computer science Use software development tools, software systems, and modern computing platforms.
4. Prepare for academic roles such as NET/SET/PhD.
5. Apply design and development principles when constructing software systems of varying complexities.
6. The program cultivates the ability to effectively communicate and collaborate as part of a team in multidisciplinary projects, utilizing essential skills for seamless coordination and cooperation.

8. Program Specific Outcomes (PSO)

1. Demonstrate understanding of the principles and working of the hardware and software aspects of computer systems.
2. Ability to understand the structure and development methodologies of software systems.
3. Possess professional skills and knowledge of software design process. Familiarity and practical competence with a broad range of programming language and open source platforms.
4. Be acquainted with the contemporary issues, latest trends in technological development and There by innovate new ideas and solutions to existing problems.

9. Course Codes

M.Sc. Semester-I		
Course Code	**Major Mandatory**	
MMT-101	Design and Analysis of Algorithms (4 credits)	**MSU0325MML99G1**
MMT-102	Advanced Database Management System (4 credits)	**MSU0325MML99G2**
MMPR-103	Practical-I (4 credits)	**MSU0325MMP99G1**
MMT-104	Web Design (2 credits)	**MSU0325MML99G3**
RM-107	Research Methodology (4 credits)	**MSU0325RML99G**
	Major Elective	
MET-105	Cyber Security (4 credits)	**MSU0325MEL99G1**
MET-106	Cloud Computing (4 credits)	**MSU0325MEL99G2**
M.Sc. Semester-II		
	Major Mandatory	
MMT-201	Advanced Java (4 credits)	**MSU0325MML99H1**
MMT-202	Artificial Intelligence (4 credits)	**MSU0325MML99H2**
MMPR-203	Practical-II (4 credits)	**MSU0325MMP99H1**
MMT-204	Angular JS (2 credits)	**MSU0325MML99H3**
OJT-207	Internship (4 credits)	**MSU0325OJ99H**
	Major Elective	
MET-205	Image Processing (4 credits)	**MSU0325MEL99H1**
MET-206	Block Chain Technology (4 credits)	**MSU0325MEL99H2**
M.Sc. Semester-III		
	Major Mandatory	
MMT-301	Advanced PHP (4 credits)	**MSU0325MML99I1**
MMT-302	Data Science (4 credits)	**MSU0325MML99I2**
MMPR-303	Practical-III (4 credits)	**MSU0325MMP99I1**
MMT-304	Data Engineering (2 credits)	**MSU0325MML99I3**
RP-307	Research Project (4 credits)	**MSU0325RP99I**
	Major Elective	
MET-305	Big Data Analytics (4 credits)	**MSU0325MEL99I1**
MET-306	Machine Learning (4 credits)	**MSU0325MEL99I2**
M.Sc. Semester-IV		
MMT-401	Mobile Application Development (4 credits)	**MSU0325MML99J1**
MMT-402	Full Stack Development (4 credits)	**MSU0325MML99J2**
MMPR-403	Practical-IV (4 credits)	**MSU0325MMP99J1**
RP-406	Research Project (6 credits)	**MSU0325RP99J**
	Major Elective	
MET-404	Natural Language Processing (4 credits)	**MSU0325MEL99J1**
MET-405	Agile Project Management (4 credits)	**MSU0325MEL99J2**

10.Syllabus

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Design and Analysis of Algorithms
Course Code: MMT-101
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Analyze the asymptotic performance of algorithms.
2. Employ graphs to model real life problems, when appropriate. Develop algorithms that employ graph computations as key components, and analyze them.
3. Mapping of data structures like Stack, Queue and Linked List to real life problems.
4. Be familiar with advanced data structures such as balanced search trees, hash tables, Red-Black trees, B-trees.
5. Understand Divide & Conquer approach, Greedy algorithm, Backtracking approach for algorithm design.
6. Be familiar with Branch and Bound & Dynamic programming

UNIT-I (15 Hours)

Algorithm Analysis: Introduction to algorithms, analyzing and designing algorithms, Growth functions, asymptotic notations, **Divide and conquer**: The maximum sub array problem, matrix multiplication, solving recurrences: Substitution method, recursion tree method, master method. Binary Search, Max-Min problem, Sorting (Merge Sort, Quick Sort). **Hashing**: Hashing, Direct address tables, Hash tables, Hash functions, collision resolution techniques.

UNIT-II (15 Hours)

Data Structures: Trees- Binary tree, binary search tree, operations on binary search tree, AVL tree, Red-Black Trees, B-trees. Graphs: Representations of graph, Traversing Graphs, Breadth-first search, Depth- First Search, topological sort.

UNIT-III (15 Hours)

Greedy Algorithm: General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Shortest paths(Dijkstra's algorithm), The Knapsack Problem, Job Scheduling Problem, Huffman code.

UNIT-IV (15 Hours)

Backtracking: Introduction, N Queen Problem, Graph Coloring, Hamiltonian Cycles Branch and Bound: Introduction, 0/1 Knapsack, Travelling Salesman problem, Dynamic programming: Introduction, Tabulation, memorization, Optimal Substructure Property in Dynamic Programming NP- Hard and NP- Complete problems: Introduction to Non deterministic, NP-Hard and NP Complete classes.

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 weisis
4. Fundamental algorithms by Donald E. Knuth, Pearson Education.

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Advanced Database Management System
Course Code: MMT-102
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Demonstrate an understanding of the relational data model.
2. Formulate, using SQL, solutions to a broad range of query and data update problems.
3. Use PL/SQL for handing data in a database as per the user's requirement using programming features
4. Define various cursors and its implementation along with procedure and functions.
5. To study usage and applications of parallel and distributed databases, object relational database.
6. To acquire knowledge on NoSQL databases.

UNIT-II (15 Hours)

Introduction to RDBMS: Introduction to DBMS & RDBMS. Data constraint- primary key, foreign key, unique key, null, not null, default key etc. 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, Steps for processing a query, Sorting , Join Operation , Hash Join . SQL functions: MAX, MIN SORT, COUNT, AVERAGE, Numeric, String, Date Functions, Type conversion functions.

UNIT-II (15 Hours)

Introduction to PL /SQL: Introduction, Difference between SQL AND PL/SQL, Block definition structure and Data types, Block Functions - %Type, %RowType, Control statements, Looping statements and sequential statement, Exception- handling. Simple PL/SQL blocks. **Cursor management:** meaning, types and importance, implicit and explicit cursor management using simple example. Trigger: meaning importance and types of trigger, examples using trigger Procedures-Definition, creating procedures, passing parameters. Function -Definition, syntax and calling methods, passing parameters.

UNIT-III (15 Hours)

Database System Architectures: Spatial data management, Web based systems, Centralized and Client-Server Architectures, Server System Architectures, Parallel System, Distributed Systems. **Parallel Databases:** Introduction, Parallel database architecture, I/O parallelism , Inter-query and Intra-query parallelism, Inter operational and Intra-operational parallelism, Design of parallel systems **Distributed Database Concepts:** Introduction, DDBMS architectures ,Homogeneous and Heterogeneous Databases , Distributed data storage, Distributed transactions, Commit protocols, Concurrency control & recovery in distributed databases ,Directory systems, Distributed Query Processing, Three tier Client Server Architecture. Object Relational Databases, Multimedia databases, Mobile databases.

UNIT-IV (15 Hours)

Introduction to NoSQL: History, concept, Different NoSQL products: MongoDB, CouchDB, Advantages of Mongo over RDBMS, CRUD operations with MongoDB, Querying, Modifying and Managing NoSQL data stores, indexing and ordering datasets, surveying database internals migrating from RDBMS to NoSQL. **Information Retrieval &**

XML data Introduction to information retrival , Indexing for Text search Web search engines ,Managing text in DBMS , Data model for XML, XML DTD's, , Domain specific DTD's ,Querying XML data .

Reference Books

1. Henry Korth, Abraham Silberschatz and S.Sudarshan,: Database System Concepts" Sixthedition,McGraw Hill,2011.
2. M.Tamer Ozsu and Patrick Valduriez,"Principles of Distributed Database System",Third edition,Springer,2011
3. R.Elmasri,S.B. Navathe," Fundamental of Data Systems",Seventh Edition,2007
4. Kristina Chodorow,"MongoDB-The Definitive Guide",Second Edition,O'Reilly,2013
5. ORACLE PL/SQL Programming Scott Ulman TMH 9th

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Practical-I
Course Code: MMPR-103

Internal Marks: 40 **External Marks: 60** **Lab: 08 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. To become familiar with programming environment.
2. To implement advanced data structures
3. Apply data structures in real life problems.
4. Able to create tables and generate queries
5. To be familiar with different types of databases.
6. Able to perform database connectivity.

Practical's will be based on MMT-101 and MMT-102

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Web Designing
Course Code: MMT-104

Internal Marks: 20 **External Marks: 30** **Theory: 02 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the basics of web design
2. Gain proficiency in HTML and CSS coding languages
3. Understand the importance CSS
4. Utilize the JavaScript with websites
5. Students will able to understand Wed API
6. Students will able to understand Entity Framework

UNIT-I **(15 Hours)**

Introduction to web design principles, overview of web development technologies and tools, understanding the role of HTML, CSS, and JavaScript, HTML basics, HTML elements, Attributes, heading, paragraphs, Styles, Formatting, Quotations, colors, links, images, table, list tags, Iframe, File paths, HTML layouts, Introduction to CSS syntax and selectors, applying styles to HTML elements, managing layouts using CSS

UNIT-II **(15 Hours)**

Overview of JavaScript and its role in web development, setting up the development environment, Writing and executing JavaScript code, Declaring and assigning variables, working with numbers, strings, booleans, and arrays, Type coercion and type conversion, Conditional statements, Switch statements, Loops, Break and continue statements, Element Access in Java scripts, Event and event handling, dialog boxes, Defining and invoking functions, working with arrays, Introduction to objects and properties, Object-oriented programming concepts

References

1. Head First HTML and CSS by Elizabeth Robson and Eric Freeman
2. HTML, CSS, and JavaScript All in One by Meloni and Kyrin's
3. HTML5 and CSS3 All-in-One For Dummies – by Andy Harris

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Cyber Security
Course Code: MET-105
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Realize the need for Cyber Security
2. Understand the need for Security in day to day communications
3. Understand the vulnerabilities in the Network and Computer System
4. Understand the cyber law and Cyber Forensics
5. Understand the mobile forensics.
6. Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.

UNIT-I (15 Hours)

Introduction to Cyber Security: Overview of Cyber Security, Cyber Threats:- Cyber Warfare- Cyber Crime- Cyber terrorism- Cyber Espionage, Cyber Security Vulnerabilities and Cyber Security Safeguards: Cyber Security Vulnerabilities - Overview, vulnerabilities in software, System administration, Weak Authentication, Poor Cyber Security Awareness. Passive attacks: Network Analysis; eavesdropping; Traffic control Active attacks: Phishing, Sniffing, spoofing, Denial of service attack. Hackers, Crackers Authentication, Biometrics, Cryptography.

UNIT-II (15 Hours)

Ethical Hacking Introduction Information Gathering and Scanning, Foot printing through Web Services, Foot printing through Social Networking Sites, Website Foot printing, Email Footprinting, Intrusion detection system: Categories of Intrusion Detection System, Types of Intrusion Detection System, Features and limitations. Intrusion prevention system:. Cryptography and Network Security: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Digital certificate, Applications of Cryptography. Firewall System: Features, Types of firewall

UNIT-III (15 Hours)

Internet Security: Secure Socket Layer(SSL), Secure Hypertext Transfer Protocol(S/HTTP), IPSec, Secure Multipurpose Internet Mail Extensions(S/MIME), E-mail Security, Encryption for Secure E-Mail, Secure E- Mail System: PGP (Pretty Good Privacy).Cyber crime: Reasons for Cyber Crime ,Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, penetration testing, Stages of Penetration Testing, Computer forensics, Cyber law: Introduction, objective of cyber law, different sections in cyber law, Roles of International Law.

UNIT-IV (15 Hours)

Introduction to Mobile Forensics – Mobile Phone Basics, cellular connected mobile device, Inside Mobile devices, data acquisition procedures for cell phones and mobile devices. Cell Phone Crime, SIM Card, SIM Security ,Mobile forensics ,Mobile forensic & its challenges , Evidences in a mobile device ,Mobile phone evidence extraction process: the evidence intake phase , identification phase, preparation phase, isolation phase, processing phase, verification phase, document and reporting phase, presentation phase.

References:

1. Preston Gralla, How Personal and Internet Security Work, Que Publications
2. Alfred Basta and Wolf Halton, Computer Security Concepts Issues and Implementation, Cengage Learning
3. Digital Defense: A Cybersecurity Primer by Joseph Pelton , Indu B. Singh
4. Cryptography and Network Security: Principles and Practice by William Stallings
5. Computer and Information Security Handbook by John R. Vacca
6. Cyberlaw: The Law of the Internet and Information Technology by Brian Craig
7. Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners 2nd Edition by Jason Andress (Author), Steve Winterfeld (Author)
8. Mastering mobile forensics by Soufiane Tahiri

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Cloud Computing
Course Code: MET-106
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Deal with the fundamentals and essentials of Cloud Computing
2. Understand the basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations
3. Understand the impact of emerging technologies on cloud computing
4. Understand cloud storage technologies and relevant distributed file systems
5. Expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research
6. Anticipate and adapt to future developments in the cloud computing industry

UNIT-I (15 Hours)
Definition, characteristics, and benefits of Cloud Computing, Evolution and history of Cloud Computing, Cloud service providers and their offerings, Overview of cloud architectures and components, Introduction to virtualization, Types of virtualization, Virtualization platforms, Managing virtual machines and virtual networks, Infrastructure as a Service (IaaS) and its components, Platform as a Service (PaaS) and its advantages, Software as a Service (SaaS) and its applications, Comparison and use cases of different service models,

UNIT-II (15 Hours)
Public, private, and hybrid clouds, Pros and cons of each deployment model, Cloud service provider selection criteria, Cloud migration strategies and considerations, Object storage, Block storage e.g. Amazon EBS, Azure Disk Storage, Database as a Service e.g. Amazon RDS, Azure Cosmos DB, Data backup and disaster recovery in the cloud, Cloud security challenges and threats, Identity and access management in the cloud, Encryption and data protection mechanisms, Compliance standards and regulations e.g. HIPAA, GDPR, Scaling principles and techniques, Load balancing and auto-scaling

UNIT-III (15 Hours)
Designing highly available and fault-tolerant architectures, Monitoring and performance optimization, DevOps principles and practices, Continuous Integration and Continuous Deployment (CI/CD), Edge computing and Internet of Things (IoT), Edge computing architectures and use cases, Deploying applications at the network edge, Edge computing innovations, Artificial Intelligence (AI) and Machine Learning (ML) in the cloud, Future directions and career opportunities in Cloud Computing

UNIT-IV (15 Hours)
Serverless Computing, Blockchain, Cloud Security and Resilience, Evolution of Cloud Gaming, Database options in the cloud, Relational and NoSQL databases, Serverless databases and scalability, Cloud-based AI services and frameworks, Latest trends and future directions in cloud computing, Introduction to quantum computing principles, Quantum computing's potential impact on cloud computing, Exploring quantum computing applications in the cloud, Overview of future trends and directions in cloud computing, Evolving cloud computing business models, Anticipating and adapting to future developments

References

1. Cloud Computing For Dummies by Judith Hurwitz
2. Cloud Computing: From Beginning to End by Mr Ray J Rafaels
3. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More by Kris Jamsa
4. Virtual Machine in Cloud Computing by Manan Shah, Charusmita Shah

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)

Title of Course: Research Methodology
Course Code: RM-107
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

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. Design and execute research studies using quantitative and qualitative approaches
5. Apply ethical considerations in conducting computer science research
6. 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 non- probability 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. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Advanced Java
Course Code: MMT-201
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. To become familiar with the features of Java Language.
2. To become comfortable with concepts such as Classes, Objects, Inheritance, Polymorphism and Interfaces.
3. To understand Database connectivity using JDBC Drivers.
4. To design application using JSP, Servlet and RMI
5. To familiar with hibernate, struts and spring framework
6. Construct cases and new ideas where the knowledge of advanced features of Java can be implemented.

UNIT-I (15 Hours)

Features of Java; Java Magic: Byte Code, OOP in Java ,Objects and classes, Inheritance, Polymorphism ,Interfaces, inner classes, Constructor, Garbage collector , Method Overloading ,Method Overriding, Packages. Understanding Class path, Introduction to Java Utility classes and collection classes-Date, DateFormat and Gregorian calendar classes. A Simple Java Program, Object Creation, Using Java.lang. Object class in program, programs using inheritance, using packages in java program

UNIT-II (15 Hours)

Java Database Connectivity: JDBC overview , Architecture , Steps to create JDBC Application, Drivers, database connection statements , Resultsets, transaction, Metadata and Aggregate functions , callable statements. Connection pooling, Java Servlets: Servlet vs CGI, Servlet life cycle , servlet basics , Generic servlet, HTTPServlet, The Servlets API, request server side –Cookies , session tracking , databases and non-HTML content , request dispatching , shared attributes, resource abstraction

UNIT-III (15 Hours)

RMI: Introduction & Architecture of RMI, Stubs & skeleton, Java RMI classes and interfaces ,Writing simple RMI application , Parameter passing in remote methods (marshalling and unmarshalling) Java Beans: Java Beans Introduction, design pattern, Beans persistence & introspection, writing simple bean. JSP(Java Server Pages: Introduction to JSP, Use of JSP, JSP Architecture, JSP tags, Implicit and Explicit objects, Request forward, Request –time include ,use of Beans in JSP and their scopes. JSF(Java Server Faces):Introduction of JSF, components of JSF, Benefits of JSF

UNIT-IV (15 Hours)

Hibernate framework application, Introduction Working on Hibernate framework, Introduction Hibernate framework, its advantage and disadvantage, Struts framework Architecture and details, Struts frameworks Components. Overview of the Spring Framework, Spring MVC Architecture Hibernate with Spring, Benefits of using Spring with Hibernate.

References:

1. The complete Reference Java- 5th edition – Herbert Schildt- Tata McGraw Hill
2. Java 8 Programming Black Book
3. Inside Java 2 Virtual Machine by Venners Bill, Mcgraw Hill Education
4. Developing Java Servlets James Goodwill, Techmedia Pub.

5. Professional JSP Wrox press
6. JDBC, Servlet and JSP, Black Book, Santosh Kumar K. Dremtech publication
7. Spring and Hibernate, Santosh Kumar K. Mc.Graw Hill Education
8. Spring Persistence with Hibernate, Ahmad Seddighi
9. Java unleashed; Micheal Morrison

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Artificial Intelligence
Course Code: MMT-202
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand working of Artificial Neural Networks.
2. Represent knowledge using knowledge representation techniques.
3. Understand working of Artificial Neural Networks.
4. Derive solutions for problems with uncertainty using Fuzzy theory.
5. To develop a good understanding of Natural Language Processing and Genetic algorithm
6. Understand the mathematical fundamentals that are prerequisites for a variety of courses like Data Mining, Network protocols, analysis of Web traffic, Computer security, Bioinformatics and Machine Learning.

UNIT I (15 Hours)

Artificial Neural Networks: Introduction, Basic Concepts of Artificial Neural Networks, Model of an Artificial Neuron, Deterministic Model of Neuron, Stochastic Model of Neuron , Activation Functions, Network Architectures: Single-Layer Feed forward Networks, Multi-Layer Feed forward Networks, Recurrent Networks, Introduction to deep learning and deep neural network.

UNIT-II (15 Hours)

Introduction to Fuzzy Set, Properties of Fuzzy sets, Operations on Fuzzy sets, fuzzy membership function, Features of Membership Functions, Defuzzification, Fuzzy Inference System (FIS): Functional Blocks of FIS, Working of FIS, Methods of FIS.

UNIT III (15 Hours)

Genetic Algorithm: Genetic Algorithm (GA), Genetic Representations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis of Selection Operations, the Hypothesis of Building Blocks, Schema Theorem and Convergence of Genetic Algorithm, Introduction to Expert System.

UNIT IV (15 Hours)

Natural Language Processing: Introduction, Phases of NLP, advantages, disadvantages, applications. Introduction to Expert Systems, Architecture of expert systems, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.

References

1. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers , Inc., San Francisco, California, 2000.
3. Saroj Kaushik , Artificial Intelligence, Cengage Learning
4. B. Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India
5. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, S. Rajasekaran, G. A. Vijayalakshmi Pai, Prentice-Hall of India, 2003
6. Artificial Intelligence: A Modern Approach, 2nd edition, by Russell and Norvig, Prentice Hall

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Practical-II

Course Code: MMPR-203

Internal Marks: 40 **External Marks: 60** **Lab: 08 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. To become acquainted with programming environment.
2. Student will be able to use advanced technology in Java such as remote method Invocation and JDBC.
3. Student will learn how to work with Java Frameworks.
4. Student will be able to develop web application using Java Servlet and Java Server Pages technology.
5. Learn how to set up a development environment for Angular JS projects
6. Students will be able to create dynamic web pages, using Servlets and JSP.

Practical's will be based on MMT-201 and MMT-204

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Angular JS
Course Code:MMT-204

Internal Marks: 20 **External Marks: 30** **Theory: 02 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the fundamental concepts of Angular JS and its role in web development
2. Learn how to set up a development environment for Angular JS projects
3. Gain proficiency in using directives, filters, and expressions to manipulate and display data
4. Build scalable applications and prepare for roles like Front-End Developer, Web App Engineer, or Full Stack Developer.
5. Angular JS and its features, benefits, setting up the development environment,
6. Angular JS application structure and file organization, Creating the first Angular JS application, Angular JS Expressions, Directives, working with built-in directives,

UNIT-I **(15 Hours)**

Introduction to Angular JS and its features, benefits, setting up the development environment, Angular JS application structure and file organization, Creating the first Angular JS application, Angular JS Expressions, Directives, working with built-in directives, creating custom directives, Controllers, Modules, Scopes, Dependency, Introduction to filters and usage, Implementing custom filters, One-way and two-way data binding, Tables, Select, DOM

UNIT-II **(15 Hours)**

Controllers and scope, Controller as syntax, Understanding dependency injection, Routing and navigation in Angular JS, Creating single-page applications (SPAs), Implementing nested views and routing, Introduction to Services and factories, Communicating with APIs using $http and $resource, Components, Creating reusable and modular components, Component-based architecture, Form validation and handling user input, Integrating external libraries and modules, Testing, debugging, and optimizing Angular JS applications

References

1. Angular: Up and Running: Learning Angular, Step by Step by Shyam Seshadri, O′Reilly
2. ANGULARJS Programming, In 8 Hours, For Beginners, Quick Start Guide: Angular JS Book Crash Course Tutorial & Exercises by Ray Yao , Dart R. Swift, Pandas C. Perl
3. Learning Angular JS: A Guide to Angular JS Development by Ken Williamson Angular JS: Angular JS. A Code Like a Pro Guide For Angular JS Beginners Kindle Edition by Jonathan Bates

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Image Processing
Course Code: MET-205

Internal Marks: 40 **External Marks: 60** **Theory: 04 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the basic principles and concepts of digital image processing.
2. Gain knowledge of different image representations and color models.
3. Learn how to pre-process and enhance images using various techniques.
4. Explore image filtering techniques for noise reduction and feature enhancement.
5. Understand the concept of image segmentation and different segmentation algorithms.
6. Analyzing general terminology of digital image processing.

UNIT-I **(15 Hours)**

Definition of digital image, pixels, representation of digital image in spatial domain as well as in matrix form. block diagram of fundamentals steps in digital image processing, application of digital image processing system, Elements of Digital Image, Processing systems, structure of the Human, Image Formation in the Eye, Brightness Adaptation and Discrimination

UNIT-II **(15 Hours)**

Introduction to image processing: basic concepts and applications, Image acquisition and representation, Image file formats and color models, Image enhancement: contrast stretching, histogram equalization, and spatial domain techniques, Noise reduction: spatial and frequency domain filtering, Image restoration: degradation model, inverse filtering, and Wiener filtering, Image sharpening techniques, Image segmentation: thresholding, region-based segmentation, and edge detection, Contour detection and boundary extraction,

UNIT-III **(15 Hours)**

Image compression: lossless and lossy compression techniques, Transform-based compression: discrete cosine transform (DCT) and wavelet transform, Image recognition and classification: principles and algorithms, Supervised and unsupervised learning techniques for image classification, Advanced topics: image registration and alignment, Super-resolution techniques, Image processing in computer vision applications, Introduction to deep learning for image processing, Similarity and Discontinuity based techniques,

UNIT-IV **(15 Hours)**

Point operations, Contrast stretching, clipping and thresholding, digital negative, intensity level slicing, log transformation, power log transformation, bit plane slicing, Unnormalized and Normalized Histogram, Histogram Equalization, Use of Histogram Statistics for Image Enhancement, Basics of Spatial Filtering, Linear filters, Spatial Low pass smoothing filters, Averaging, Weighted Averaging, Non-Linear filters, Median filter, Maximum and Minimum filters

References

1. Digital Image Processing by Rafael C. Gonzalez
2. Principles of Digital Image Processing Core Algorithms by Wilhelm Burger and Mark J. Burge
3. Fundamentals of Digital Image Processing by Annadurai
4. Fundamentals of Digital Image Processing by Jain A K

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Block Chain Technology
Course Code: MET-206
Total Credits: 04
Internal Marks: 40 External Marks: 60 Theory: 04 hours/week

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the concept of Block chain Technology, transactions, block, PoW, Consensus
2. Understand the simulation of block chain technology without any central controlling or trusted agency and how bitcoin crypto currency work.
3. Understand the concept of digital currency, how it can be protected against fraud, scam, hacking and devaluation.
4. Understand the concept of bitcoin and Etherum
5. Explain the modern concepts of block chain technology systematically.
6. Analyze the application and impact of blockchain technology in the financial industry and other industries.

UNIT-I (15 Hours)

History of Blockchain Technology: Basics of blockchain, History, Uses of Blockchain, Structure of a block, Transactions, Understand the difference between centralized, decentralized and distributed peer to peer networks, Types of blockchains, Objectives of consensus mechanisms, famous hacks, wallet, security and safeguards Public Ledger, Distributed Consensus.

UNIT-II (15 Hours)

Cryptographic Primitives and Overview of what is blockchain: Cryptographic hash functions – collision free, hiding, puzzle friendly (properties), Hash Chain, Hash tree- Merkle Tree, Public Key cryptography, Digital signatures. Use of hash functions and digital signatures in blockchain, recording transaction, confirmation and verification of transaction, consensus building: distributed consensus, Consensus mechanism: PoW, PoS, PoB, PoA, blockchain architecture, Merkle root tree.

UNIT-III (15 Hours)

Bitcoin and Etherum: History of bitcoin, Double Spending, Script (FORTH), Mining Process, History, Architecture, Account Types , Gas, Transactions, Introduction to etherum, Ethereum Virtual Machine, Ethereum Mining process, Solidity. Hyperledger Fabric: Features of hyperledger, Architecture, ordering service, Transaction Flow, Membership and Identity Mangement

UNIT-IV (15 Hours)

Case Study: Blockchain in Government Digital Identity, Healthcare, Land Registration, Supply Chain Management

References:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press
2. Don Tapscott,AlexTapscott, Blockchain Revolution, ISBN No. 9781101980132
3. Mark Gates, Blockchain ultimate Guide to understanding Blockchain, Bitcoin, Cryptocurrencies, Smart Contracts and Future of money, Wise Fox Publishing
4. Vikram Dhillon, David Metcalf, Max Hooper, Blockchain Enabled Applications, Apress, ISBN No.13:978-1-4842-3081-7
5. Melanie Swan, Blockchain Blueprint for a new economy, O'Reilly, First Edition, ISBN No.978-1-491-92049-7
6. Chris Dannen, Introducing Ethereum and Solidity, Apress, ISBN No.978-1-4842- 2535-6

M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)

Title of Course: Internship
Course Code: OJT-207

Internal Marks: 40 **External Marks: 60** **Theory: 04 hours/week**

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Gain industrial experience
2. Students should be able to learn office ethics
3. Students should be able to learn to work in team
4. Reflect and evaluate on experiences that might lead to future employment.
5. Demonstrate and apply research skills to complete a project
6. Apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach.

Student is supposed to carry out on job training during his/her semester vacation.

Scheme of Teaching

1. Each contact session for teaching or practical should be of 60 minutes each.
2. 60 lectures should be conducted for each course of 4 credits and 30 lectures for 2 credits.
3. One Practical Batch should be of 30 students.
4. Practical evaluation should be conducted before the commencement of University examination

11. Examination Pattern

Theory:

- **For 4 credit course-** University examinations: 60 marks, Internal evaluation: 40 marks
    - Two tests should be conducted of MCQ type questions. Each test will be of 10 marks
    - Assignments/Seminar/Activities carries 20 marks
- **For 2 credit course-** University examinations: 30 marks, Internal evaluation: 20 marks
    - One test should be conducted of MCQ type questions of 10 marks.
    - Assignments/ Seminar carries 10 marks

- 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:

Practical evaluation will be through university appointed panels of external and internal examiners.

Project:

- **For 4 credit course-** University examinations: 60 marks, Internal evaluation: 40 marks
    - Project viva by university appointed external and internal examiners.
    - Internal evaluation will be carried out by internal guide.

12. Nature of Question Paper and Scheme of Marking

Theory:

1) There will be Seven (7) questions of 12 Marks and out of which Four (4) to be attempted from question no 2 to 7.

2) Question No.1 is compulsory and is of multiple choice questions. There will be 6 multiple choice question each carries 2 marks

3) Question No.2 to Question No. 6 should consist 2 sub question each carries 6 marks

4) Question No. 7 should be short note types consisting of 4 sub questions out of which 2 needs to be attempted each carries 6 marks.

Practical:

1) Duration of Practical Examination: 2.30 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	20 Marks
3	Journal	20 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:

Student has to make a presentation of the work carried out during On Job Training in front of a panel external and internal examiners. He/she has to submit the report of work carried out as part of On Job Training.

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.

Backlog

Student should not have more than 6 backlogs for 2nd year admission

13. Equivalence of courses

M. Sc. Part I (Semester I and II)

Old Course				Equivalent Course		
Sem No.	**Course Code**	**Title of Old Course**	**Credit**	**Course Code**	**Title of New Course**	**Credit**
I	CC-101	Design and Analysis of Algorithm	4	MMT-101	Design and Analysis of algorithm	4
I	CC-102	Python Programming	4	---	***No equivalence**	--
I	CC-103	Database Management System	4	MMT-102	Advanced Database Management System	4
I	CC-104	Cyber Security	4	---	***No equivalence**	--
II	CC-201	Web Technology	4	---	***No equivalence**	--
II	CC-202	Advanced Java	4	MMT-201	Advanced Java	4
II	CC-203	Android development with Kotlin	4	MMT-401	Mobile Application Development	4
II	CCS-204	1.Software Project Management	4	---	***No equivalence**	--
II	CCS-204	2.Data Science Foundation	4	MMT-302	**Data Science**	4
II	CCS-204	3.Application Security Analyst	4	---	***No equivalence**	--
II	CCS-204	4.Cloud Computing	4	MET-106	**Cloud Computing**	4

*** Two more chances are given to the student.**