



SU/BOS/Science/ 91

Date: 25 / 01 / 2024

To,

The Director,  
Centre for Distance and Online Education,  
Shivaji University, Kolhapur.

**Subject :- Regarding Syllabi of M. Sc. Part- I & II Computer Science (Online Mode) (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020**

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 and Nature of question paper of **M. Sc. Part- I & II Computer Science (Online Mode)** under the Faculty of Science and Technology as per National Education Policy 2020 .

This syllabi and nature of question paper shall be implemented from the Academic Year **2023-2024 & 2024-2025** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in) (students Online Syllabus)

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

Thanking you,

Yours Faithfully

  
( Dr. S. M. Kubal )  
Dy Registrar

Encl : As above

Copy to:

For Information and necessary action.

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

# SHIVAJI UNIVERSITY, KOLHAPUR



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 Science (Computer Science) Online Mode**

**Part I**

under

**Faculty of Science and Technology**

**(To Be Implemented From Academic Year 2023-24)**

## **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.
- ✓ 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 +<br>Tutorial/<br>(Hours/<br>week) | Practical<br>(Hours/<br>week) | Credit | Maximum<br>Marks           | Minimum<br>Marks | Exam. Hours | Maximum<br>Marks         | Minimum<br>Marks | Exam.<br>Hours |
| <b>Semester-I</b>               |             |   |                               |        |                            |                  |             |                          |                  |                |
| <b>Major<br/>Mandatory</b>      | MMT-101     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-102     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMPR-103    | --  | 8                             | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-104     | 2   | --                            | 2      | 40                         | 16               | 2           | 10                       | 4                | 1              |
| <b>Major<br/>Elective</b>       | MET-105     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MET-106     |   |                               |        |                            |                  |             |                          |                  |                |
| <b>Research<br/>Methodology</b> | RM-107      | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
| <b>Total</b>                    |             |   |                               | 22     | 440                        |                  |             | 110                      |                  |                |
| <b>Semester-II</b>              |             |   |                               |        |                            |                  |             |                          |                  |                |
| <b>Major<br/>Mandatory</b>      | MMT-201     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-202     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMPR -203   | --  | 8                             | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-204     | 2   | --                            | 2      | 40                         | 16               | 2           | 10                       | 4                | 1              |
| <b>Major<br/>Elective</b>       | MET-205     | 4   | --                            | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MET-206     |   |                               |        |                            |                  |             |                          |                  |                |
| <b>OJT/FP</b>                   | OJT-207     | --  | --                            | 4      |                            |                  | *           |                          |                  |                |
| <b>Total</b>                    |             |   |                               | 22     | 440                        |                  |             | 110                      |                  |                |
| <b>Total (Sem I + Sem II)</b>   |             |   |                               | 44     |                            |                  |             |                          |                  |                |

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• MMT–Major Mandatory Theory</li> <li>• MMPR–Major Mandatory Practical</li> <li>• MET–Major Elective Theory</li> <li>• MEPR–Major Elective Practical</li> <li>• RM - Research Methodology</li> <li>• OJT/FP- On Job Training/ Field Project</li> </ul> | <ul style="list-style-type: none"> <li>• Total Marks for M.Sc.-I : <b>1100</b></li> <li>• Total Credits for M.Sc.-I (Semester I &amp; II) : 44</li> <li>• <b>Separate passing is mandatory for University and Internal Examinations</b></li> </ul> |
| <p>*Evaluation scheme for OJT/FP shall be decided by concerned BOS</p>  |  |
| <ul style="list-style-type: none"> <li>• <b>Requirement for Entry at Level 6.0: Completion of Level 5.5</b></li> </ul>  |  |
| <ul style="list-style-type: none"> <li>• <b>Requirement for Exit after Level 6.0:</b><br/>Students can exit after completion of Level 6.0 with Post Graduate Diploma in Computer Science</li> </ul>   |  |
| <ul style="list-style-type: none"> <li>• <b>Requirement for Entry at Level 6.5: He/ She have completed MSc Part-I (Level 6.0)</b></li> </ul>  |  |

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

|                                 | Course Code | Teaching Scheme                      |                        |        | Examination Scheme         |                  |             |                          |                  |                |
|---------------------------------|-------------|--------------------------------------|------------------------|--------|----------------------------|------------------|-------------|--------------------------|------------------|----------------|
|                                 |             | Theory and Practical                 |                        |        | University Assessment (UA) |                  |             | Internal Assessment (IA) |                  |                |
|                                 |             | Lectures +<br>Tutorial<br>(Per week) | Hours<br>(Per<br>week) | Credit | Maximum<br>Marks           | Minimum<br>Marks | Exam. Hours | Maximum<br>Marks         | Minimum<br>Marks | Exam.<br>Hours |
| <b>Semester-III</b>             |             |                                      |                        |        |                            |                  |             |                          |                  |                |
| <b>Major<br/>Mandatory</b>      | MMT-301     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-302     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMPR -303   | --                                   | 8                      | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-304     | 2                                    | --                     | 2      | 40                         | 16               | 2           | 10                       | 4                | 1              |
| <b>Major<br/>Elective</b>       | MET-305     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MET-306     |                                      |                        |        |                            |                  |             |                          |                  |                |
| <b>Research<br/>Project</b>     | RP-307      | --                                   | --                     | 4      | 80                         | 32               | --          | 20                       | 8                | --             |
| <b>Total</b>                    |             |                                      |                        | 22     | 440                        |                  |             | 110                      |                  |                |
| <b>Semester-IV</b>              |             |                                      |                        |        |                            |                  |             |                          |                  |                |
| <b>Major<br/>Mandatory</b>      | MMT-401     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMT-402     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MMPR-403    | --                                   | 8                      | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
| <b>Major<br/>Elective</b>       | MET-404     | 4                                    | --                     | 4      | 80                         | 32               | 3           | 20                       | 8                | 1              |
|                                 | MET-405     |                                      |                        |        |                            |                  |             |                          |                  |                |
| <b>Research<br/>Project</b>     | RP-406      | --                                   | --                     | 6      | 100                        | 40               | --          | 50                       | 20               | --             |
| <b>Total</b>                    |             |                                      |                        | 22     | 420                        |                  |             | 130                      |                  |                |
| <b>Total (Sem III + Sem IV)</b> |             |                                      |                        | 44     |                            |                  |             |                          |                  |                |

|  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• MMT–Major Mandatory Theory</li> <li>• MMPR–Major Mandatory Practical</li> <li>• MET–Major Elective Theory</li> <li>• MEPR–Major Elective Practical</li> <li>• RP- Research Project</li> </ul> | <ul style="list-style-type: none"> <li>• Total Marks for M.Sc.-II : <b>1100</b></li> <li>• Total Credits for M.Sc.-II (Semester III &amp; IV) : 44</li> <li>• <i>Separate passing is mandatory for University and Internal Examinations</i></li> </ul> |
| <p># Evaluation scheme for Research Project shall be decided by concerned BOS</p>  |  |
| <p>## Evaluation scheme for Research Project shall be decided by concerned BOS</p>   |  |
| <ul style="list-style-type: none"> <li>• <b>Requirement for Exit after Level 6.5:</b><br/> <b>Students can exit after completion of Level 6.5 with Master of Computer Science</b></li> </ul>   |  |

## **6. Programme Outcomes (POs)**

Upon successful completion of the M.Sc. the student should have met the following Student Learning Outcomes:

1. Students will acquire the ability to identify and formulate research problems, enabling them to contribute to the advancement of knowledge in the field of computer science
2. Identify, analyze, and synthesize scholarly literature relevant to the field of computer science.
3. Employ 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.



## 7. Course Codes

| <b>M.Sc. Semester-I</b>   |   |                |
|---------------------------|---|----------------|
| Course Code               | <b>Major Mandatory</b>                          |                |
| 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  |
| <b>Major Elective</b>     |   |                |
| MET-105                   | Cyber Security (4 credits)                      | MSU0325MEL99G1 |
| MET-106                   | Operating System (4 credits)                    | MSU0325MEL99G2 |
| <b>M.Sc. Semester-II</b>  |   |                |
| <b>Major Mandatory</b>    |   |                |
| MMT-201                   | Java Programming (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   |
| <b>Major Elective</b>     |   |                |
| MET-205                   | Image Processing (4 credits)                    | MSU0325MEL99H1 |
| MET-206                   | Block Chain Technology (4 credits)              | MSU0325MEL99H2 |
| <b>M.Sc. Semester-III</b> |   |                |
| <b>Major Mandatory</b>    |   |                |
| 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   |
| <b>Major Elective</b>     |   |                |
| MET-305                   | Big Data Analytics (4 credits)                  | MSU0325MEL99I1 |
| MET-306                   | Machine Learning (4 credits)                    | MSU0325MEL99I2 |
| <b>M.Sc. Semester-IV</b>  |   |                |
| 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 (4 credits)                    | MSU0325RP99J   |
| <b>Major Elective</b>     |   |                |
| MET-404                   | Natural Language Processing (4 credits)         | MSU0325MEL99J1 |
| MET-405                   | Agile Project Management (4 credits)            | MSU0325MEL99J2 |

## 8. Syllabus

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Design and Analysis of Algorithms**

**Course Code: MMT-101**

**Total Credits: 04**

**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:** Stacks, Queues, Linked list, Trees, General tree, 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, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code.

### **UNIT-IV (15 Hours)**

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

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Advanced Database Management System**

**Course Code:MMT-102**

**Total Credits: 04**

**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 handling 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 retrieval , 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” Sixth edition,McGraw Hill,2011.
2. M.Tamer Ozsü 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)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Practical-I**

**Course Code:MMPR-103**

**Total Credits: 04**

**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.

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

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Web Designing**

**Course Code:MMT-104**

**Total Credits: 02**

**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

**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)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Cyber Security**

**Course Code: MET-105**

**Total Credits: 04**

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

1. Realize the need for Cyber Security
2. Understand the fundamentals of Cyber crimes and Cyber security
3. Understand the need for Security in day to day communications
4. Understand the vulnerabilities in the Network and Computer System
5. Understand the cyber law and Cyber Forensics

### **Unit 1**

Introduction to Cyber Security: Overview of Cyber Security, Internet Governance Challenges and Constraints, Cyber Threats: Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace. Cyber Security Vulnerabilities and Cyber Security Safeguards Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

### **Unit II**

Securing Web Application, Services and Servers: Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

### **Unit III**

Cryptography and Network Security: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls Types of Firewalls, User Management, VPN Security Protocols: security at the Application Layer PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

### **Unit IV**

Cyberspace and the Law: Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013. Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding. Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

**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)



**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Operating Systems**

**Course Code: MET-106**

**Total Credits: 04**

**M.Sc.-I Semester-I (Computer Science) (Online Mode)**

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

1. To understand the basic concepts and functions of operating systems.
2. To understand Processes and Threads
3. To analyze Scheduling algorithms.
4. To understand the concept of Deadlocks.
5. To analyze various memory management schemes.
6. To understand I/O management and File systems.
7. To be familiar with the basics of Distributed Operating System

### **Unit I**

Introduction: Operating system definition, Functions of Operating System, Logical View, System View, Types of operating System, System Calls, System Programs, Interrupt Concept, Concept of Virtual Machine, Processes: Process Concept, Thread Concept, Difference between Process and Thread, Process Control Block, Process operations, Inter-process Communication.

### **Unit I**

CPU Scheduling: Scheduling Concept, Scheduling Criteria, Scheduling algorithms, Scheduling Evaluation, Simulation Concept, Numerical Exercises Based on CPU Scheduling Algorithms. Process Synchronization: Synchronization concept, Need for Synchronization, Critical Section Problem, Semaphore, Monitor. Deadlock: Deadlock concepts, Necessary Conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance, Bankers Algorithm, Deadlock Detection, Deadlock Recovery.

### **Unit III**

Memory Management: Concept, Memory Management Techniques, Contiguous & NonContiguous allocation, Relocation, Compaction, Logical & Physical Memory, Conversion of Logical to Physical address, Paging, Segmentation, Segment with paging, Virtual Memory Concept, Demand paging, Page fault, Need for Page Replacement, Page Replacement algorithms, Thrashing.

### **Unit IV**

Disk Management: Disk Structure, Disk Scheduling algorithm, Disk management, Swap Space concept and Management, RAID structure, Disk performance issues, Distributed

Operating System: Difference between Distributed & Centralized OS, Advantages of Distributed OS, Types of Distributed OS.

**References:**

1. Operating System Silberschatz, Galvin , Gagne, Wiley publication
2. Operating System Concepts and Design , Milan Milenkovic, MGH
3. Distributed Operating System P.K. Sinha, PHI
- 4, Operating system AchyutGodbole
5. Operating System In Depth Doeppner Wiley India
6. Operating System Rohit KhuranaVikas pub

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester I)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Research Methodology**

**Course Code:RM-107**

**Total Credits: 04**

**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)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Java Programming**

**Course Code: MMT-201**

**Total Credits: 04**

**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 Exception handling
4. To design applications using threads.
5. To get familiar with networking classes
6. To design GUI applications using applets.

### **Unit I**

OOPS in JAVA: Objects and classes, Inheritance, Interfaces, inner classes, packages. Introduction to Java Utility classes and collection classes - Date, DateFormat and GregorianCalendar classes. Using ListInterface, ListIterator and LinkedList classes. Set, Iterator, SortedSet, Map interfaces. HashSet class. Using Vector class, stacks, queues, HashTable. Generating random numbers, Property class.

### **Unit II**

Exception Handling and I/O Streams: Exception Handling: Exception class hierarchy, Exception Vs Error, try, catch, throw, throws, finally, checked Vs unchecked exceptions, creating custom exception classes. Significance of streams, various types of Input & Output streams, accessing the file through streams, object serialization. Random Access File.

### **Unit III**

**Multi Threading and Networking in Java:** Difference between multi tasking and multithreading, Need for multi threading, thread states and priorities, suspending and resuming threads, synchronization between threads. Inter thread communication and dead locks Client and Server programming, Connection oriented and connectionless architectures, Socket, IP address classes. InetAddress, URL and URLConnection classes.

### **Unit IV**

**Applets and Event Handling in Java:** Applet and its life cycle, passing parameters to applets, font, color, image classes. Image Observer. Image processing using Pixel Grabber and Memory Image Source classes. Difference between AWT and Swing. Light weight and heavy weight components. Pluggable Look and Feel. Swing package and its components, layout managers, various components for GUI. Delegation Event Model, different types of events, event handlers, and adapter classes.

## References:

1. Java Complete Reference by Patric Norton
2. Java 8 Programming Black Book
3. Core Java Vol. I (Addison- Wesley) Sun Press ISBN 981-405-861-0
4. Core Java Vol. II (Addison- Wesley) Sun Press ISBN 981-4058-50-5
5. Java in a Nutshell, By Benjamin J Evans, David Flanagan, O'Reilly Media
6. Thinking in Java, Bruce Eckel,, Addison — Wesley, ISBN: 9814035750
7. Java 2 Programming Black Book by Steven Holzner, Dream Tech Publication
8. A Programmer's Guide to Java SCJP Certification: A Comprehensive Primer By Khalid Azim Mughal, Rolf Rasmussen
9. Inside Java 2 Virtual Machine by Venner's Bill, McGraw Hill Education
10. Learning Java by Jonathan Knudsen, Patrick Niemeyer, O'Reilly Media

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Artificial Intelligence**

**Course Code: MMT-202**

**Total Credits: 04**

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

1. Apply problem solving by intelligent search approach.
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

**UNIT-I** **(15 Hours)**

**Introduction of AI and Problem Solving:** Artificial Intelligence, AI Problems, AI Techniques, Defining the Problem as a State Space Search, uninformed search and informed search, heuristic search, hill climbing, Best first search, A\* algorithm, AO\* algorithm, constraint satisfaction, Game playing: Minmax search procedure, refining Minmax, Alpha – Beta pruning,

**UNIT-II** **(15 Hours)**

**Knowledge Representation:** Introduction, Propositional Logic, Syntax and Semantics, Interpretations, Properties, Predicate logic, WFF, Free and Bound Variables, Normal Forms, Inference Techniques, Resolution, Unification, Modes Ponens, Frames, Frame Representation Language, Semantic Net, Forward and Backward Reasoning

**UNIT-III** **(15 Hours)**

**Artificial Neural Networks:** Introduction, Basic Concepts of Artificial Neural Networks, Model of an Artificial Neuron, Activation Functions, Feed forward Network, Recurrent Network, Introduction to deep learning and deep neural network. **Fuzzy Set Theory**, Fuzzy Membership, Fuzzy Operations, Fuzzy Logic Systems.

**UNIT-IV** **(15 Hours)**

**Natural Language Processing:** Introduction, Phases of NLP, advantages, disadvantages, applications. **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.

**Reference Book**

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 B. Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India
4. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, S.
5. Rajasekaran, G. A. Vijayalakshmi Pai, Prentice-Hall of India, 2003
6. Artificial Intelligence: A Modern Approach, 2nd edition, by Russell & Norvig, Prentice

**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Practical-II**

**Course Code: MMPR-203**

**Total Credits: 04**

**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. Design and develop solutions for informed and uninformed search problems in AI.

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



**M. Sc. (Computer Science) (Part I) (Level-6.0) (Semester II)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Angular JS**

**Course Code:MMT-204**

**Total Credits: 02**

**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

**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)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Image Processing**

**Course Code: MET-205**

**Total Credits: 04**

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

**Course Outcomes:**

1. Understand the basic principles and concepts of digital image processing.
2. Gain knowledge of different image representations and colour 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.

**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)**  
**(NEP-2020)**  
**(Introduced from Academic Year 2023-24)**

**Title of Course: Block Chain Technology**

**Course Code: MET-206**

**Total Credits: 04**

**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 Ethereum

**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 Ethereum: History of bitcoin, Double Spending, Script (FORTH), Mining Process, History, Architecture, Account Types , Gas, Transactions, Introduction to ethereum, 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, Alex Tapscott, 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)**

**(NEP-2020)**

**(Introduced from Academic Year 2023-24)**

**Title of Course: Internship**

**Course Code: OJT-207**

**Total Credits: 04**

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

1. gain industrial experience
2. learn office ethics
3. learn to work in team

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

## 12. 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      | ---               | <b>*No equivalence</b>              | --     |
| I          | CC-103      | Database Management System       | 4      | MMT-102           | Advanced Database Management System | 4      |
| I          | CC-104      | Cyber Security                   | 4      | ---               | <b>*No equivalence</b>              | --     |
| II         | CC-201      | Web Technology                   | 4      | ---               | <b>*No equivalence</b>              | --     |
| 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      | ---               | <b>*No equivalence</b>              | --     |
| II         | CCS-204     | 2. Data Science Foundation       | 4      | MMT-302           | <b>Data Science</b>                 | 4      |
| II         | CCS-204     | 3. Application Security Analyst  | 4      | ---               | <b>*No equivalence</b>              | --     |
| II         | CCS-204     | 4. Cloud Computing               | 4      | MET-106           | <b>Cloud Computing</b>              | 4      |

**\* Two more chances be given to the student.**