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

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE : EPABX – 2609000,
www.unishivaji.ac.in, **bos@unishivaji.ac.in**

शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४,महाराष्ट्र

दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१—२६०९०९३/९४

SU/BOS/Science/757 **Date: 17/ 10/ 2023**

To,

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

The Head,
All Concerned Department
Shivaji University,
Kolhapur.

Subject: Minor Change in Syllabi of **MCA., & M. Sc. Part –I (Sem.I&II) Computer Science Engineering & Technology,** (NEP-2020) degree Programme under the Faculty of Science and Technology as per National Education Policy 2020.

*References **1. MCA. Part –I /BOS/Science/500 Date.10/07/2023**
2. M. Sc. Part –I/BOS/Science/499 Date.10/07/2023

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 Minor Change in syllabi of **MCA., & M. Sc. Part –I (Sem.I&II) Computer Science Engineering & Technology,** under the Faculty of Science and Technology.

Sr. No.		Programme/Course
1	Computer Science Engineering & Technology	1. MCA. Part –I (Sem.I&II) 2. M. Sc. Part –I (Sem.I&II)

This Cousre Syllabi shall be implemented from the Academic Year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website 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,

Dy Registrar
(Dr. S. M. Kubal)

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

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 Computer Applications

Part I

under

Faculty of Science and Technology

(To Be Implemented From Academic Year 2023-24)

1. Preamble

The basic objective of the education in Masters Programme as Computer Application (MCA) is to provide to the country a steady stream of the necessary knowledge, skills and foundation for acquiring a wide range of rewarding careers into the rapidly expanding world of the Information Technology. The program addresses the job requirements in many upcoming domains such as cyber security, mobile computing, cloud computing, IoT, Robotics, Data Science and the one involving assortment of hardware and software. Career opportunities also exist in areas such as management software and hardware sales, technical writing, training others on current IT skills, consulting, software development and technical support.

2. Duration

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

3. Eligibility for Admission

- Eligibility: Passed minimum three year duration Bachelor's Degree awarded by HEI recognized by University Grants Commission or Association of Indian Universities in any discipline with at least 50% marks in aggregate or equivalent (at least 45% in case of candidates of backward class categories belonging to Maharashtra state only. 45% is also applicable to differently abled students)

- 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.C.A. (Science) Part – I (Level-6.0)

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures + Tutorial/ (Hours/ week)	Practical (Hours/ week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-I										
Major Mandatory	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
Major Elective	MET-105 MET-106	4	--	4	80	32	3	20	8	1
Research Methodology	RM-107	4	--	4	80	32	3	20	8	1
Total				22	440			110		
Semester-II										
Major Mandatory	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
Major Elective	MET-205 MET-206	4	--	4	80	32	3	20	8	1
OJT/FP	OJT-207	--	--	4	80	32	3	20	8	1
Total				22	440			110		
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.C.A.-I : **1100**
- Total Credits for M.C.A. -I (Semester I & II) : 44
- ***Separate passing is mandatory for University and Internal Examinations***

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<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 Application

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- **Requirement for Entry at Level 6.5: He/ She have completed MCA Part-I (Level 6.0)**

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

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

• MMT–Major Mandatory Theory • MMPR–Major Mandatory Practical • MET–Major Elective Theory • MEPR–Major Elective Practical • RP- Research Project	• Total Marks for M.C.A..-II : **1100** • Total Credits for M.C.A.-II (Semester III & IV) : 44 • ***Separate passing is mandatory for University and Internal Examinations***
# Evaluation scheme for Research Project shall be decided by concerned BOS	
## Evaluation scheme for Research Project shall be decided by concerned BOS	
• **Requirement for Exit after Level 6.5:** **Students can exit after completion of Level 6.5 with Master of Computer Application**	

6. Programme Outcomes (POs)

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

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

7. Course Codes

M.C.A. Semester-I		
Course Code	**Major Mandatory**	
MMT-101	Advanced Data Structures (4 credits)	**MSU0325MML929G1**
MMT-102	Database Management System (4 credits)	**MSU0325MML929G2**
MMPR-103	Practical-I (4 credits)	**MSU0325MMP929G1**
MMT-104	Cyber Security (2 credits)	**MSU0325MML929G3**
RM-107	Research Methodology (4 credits)	**MSU0325RML929G**
	Major Elective	
MET-105	Computer Networks (4 credits)	**MSU0325MEL929G1**
MET-106	Computer Architecture (4 credits)	**MSU0325MEL929G2**
M.C.A. Semester-II		
	Major Mandatory	
MMT-201	Advanced Operating System (4 credits)	**MSU0325MML929H1**
MMT-202	Java Programming (4 credits)	**MSU0325MML929H2**
MMPR-203	Practical-II (4 credits)	**MSU0325MMP929H1**
MMT-204	Web Technology (2 credits)	**MSU0325MML929H3**
OJT-207	Internship (4 credits)	**MSU0325OJ929H**
	Major Elective	
MET-205	Network Security (4 credits)	**MSU0325MEL929H1**
MET-206	Software Engineering (4 credits)	**MSU0325MEL929H2**
M.C.A. Semester-III		
	Major Mandatory	
MMT-301	Artificial Intelligence (4 credits)	**MSU0325MML929I1**
MMT-302	Front End Development (4 credits)	**MSU0325MML929I2**
MMPR-303	Practical-III (4 credits)	**MSU0325MMP929I1**
MMT-304	PHP (2 credits)	**MSU0325MML929I3**
RP-307	Research Project (4 credits)	**MSU0325RP929I**
	Major Elective	
MET-305	Cloud Computing (4 credits)	**MSU0325MEL929I1**
MET-306	Data Science (4 credits)	**MSU0325MEL929I2**
M.C.A. Semester-IV		
MMT-401	Mobile Application Development (4 credits)	**MSU0325MML929J1**
MMT-402	Back End Development (4 credits)	**MSU0325MML929J2**
MMPR-403	Practical-IV (4 credits)	**MSU0325MMP929J1**
RP-406	Research Project (6 credits)	**MSU0325RP929J**
	Major Elective	
MET-404	Block Chain Technology (4 credits)	**MSU0325MEL929J1**
MET-405	Machine Learning (4 credits)	**MSU0325MEL929J2**

8. Syllabus

M. C. A. Science (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Advanced Data Structures
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. Compare algorithms based on time & space complexity.
3. To learn how data structure concepts are useful in problem solving..
4. To implement different ways of data structures such as stacks, linked lists and trees
5. Understand different algorithm design approaches.

UNIT -1 **(15 Hours)**
Algorithm Analysis: Introduction to algorithms, analyzing and designing algorithms, Growth functions, asymptotic notations, Recursive algorithm complexity, solving recurrences: Substitution method, recursion tree method, master method. **Searching**: Binary search, **Hashing**: Hashing, Hash tables, Hash functions, collision resolution techniques. **Sorting**: Quick sort, Counting sort, Radix sort, Merge sort, Heap sort, Insertion sort and selection sort.

UNIT- II **(15 Hours)**
Linear Data Structures: Linked Lists: Linked Representation in memory, traversing and searching a linked list, insertion and deletion from a linked list, singly, doubly and circular linked list. Stack: Definition, array and linked representation of stacks, arithmetic expression: polish notation, application of stack, Queue: Definition, array and linked representation ofQueue, priority queues.

UNIT- III **(15 Hours)**
Non-Linear Data Structures:
Trees, General tree, Binary tree, binary search tree, operations on binary search tree, AVL Trees, Single rotation, Double rotation, Red-Black Trees, B-Trees: Definition of B-trees, Basic operations on B-trees, deleting a key from a B-tree. **Graphs**: Representations of graph, Traversing Graphs, Breadth-first search, Depth-First Search, topological sort, Minimum Spanning trees, Single source shortest path, All pairs shortest path.

UNIT- IV **(15 Hours)**
Algorithm design approaches:
Greedy Algorithm: General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code. **Backtracking**: Introduction, N Queen Problem, Subset Sum, Hamiltonian Cycle, **Branch and Bound** – Introduction, 0/1 Knapsack, Travelling Salesman problem **Dynamic programming**: Introduction, Tabulation, memorization, Optimal SubstructureProperty in Dynamic Programming

References:

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

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

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

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

UNIT-I **(15 Hours)**
Basics of DBMS: Database Concept, Characteristics and architecture of DBMS, Database users, 3-tier architecture of DBMS-its advantages over 2-tier, Introduction of Parallel, Distributed Databases, Mobile databases and Cloud databases. Data independence. Physical data organization, Indexing-introduction and types of indexing.

UNIT- II **(15 Hours)**
Introduction to RDBMS:-Entity introduction, characteristics, Comparison between DBMS, RDBMS, Generalization and Aggregation Normalization- Functional dependency, types of normalization(1NF,2NF,3NF,BCNF),Data constraint- primary key, foreign key, unique key, null, not null, default key etc. **Relational Algebra Concepts**; introduction, Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra;

UNIT- III **(15 Hours)**
SQL: Introduction to SQL, Features of SQL, Basic data types, SQL statements/commands, Set operations in SQL, order by and group by clause, like between, in, like, create index , view and join command Nested queries, GRANT and REVOKE, Commit, Rollback, Save point. Join concept: Simple, Equi, non-equi, Self, Outer join. View. **Introduction to PL /SQL:** Introduction, Difference between SQL AND PL/SQL, Block definition structure and Data types, Block Functions, cursor, trigger, procedures, exception handling. **No SQL Database** - Introduction, Need& Advantages ,Types of No SQL Database , No SQL database vs RDBMS

UNIT- IV **(15 Hours)**
Concurrency Control and Transaction Management: Transaction processing **Concurrency -** Concept of transaction processing, ACID properties, States of transaction, Serializibility, Concurrency control, schemes, Locking techniques, Timestamp based protocols, Granularity of data items, Deadlocks. Database recovery and Backup.

References:
1.Introduction to database systems C. J. Date Pearsons Education 8th
2.Database system concept Korth, Silberschatz and Sudarshan MGH 5th
3.Fundamentals of Database Systems Elmasri Navathe PearsonEducation5th
4.SQL /PL SQL For Oracle 11G BlackBook Dr.Deshpande Wiley Dreamtech 2012
5.ORACLE PL/SQL Programming Scott Ulman TMH 9th
6.SQL, PL/SQL the programming language of Oracle Ivan Bayross BPB 4th
7.Advance Database Management System hakrabharati, Dasgupta Wiley Dreamtech2011
8.NoSQL Distilled: A Brief Guide to the Emerging World of PolyglotPersistence Martin Fowler

M. C. A. 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 linear data structures.
3. Able to create tables and generate queries
4. Apply data structures in real life problems.

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

M. C. A. Science (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Cyber Security
Course Code:MMT-104
Total Credits: 02
Course Outcomes: Upon successful completion of this course, the student will be able to:

1) Realize the need for Cyber Security
2) Understand the vulnerabilities in the Network and Computer System
3) Understand social media forensics.

Unit-I (15 hr)
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 hr)
Ethical Hacking, Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Digital certificate, Applications of Cryptography, Social media forensics: Types of social networking platforms, social media crimes: hacking, photo morphing, offer & shopping scams, Dating scams, Cyber bullying, Link Baiting. Evidence Collection in Social Media Forensics: Evidence Identification, Collection, Examination

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 Defence: A Cyber security Primer by Joseph Pelton , Indu B. Singh
4. Cryptography and Network Security: Principles and Practice by William Stallings
5. Cyber Warfare: Techniques, Tactics and Tools for Security Practitioners 2nd Editionby Jason Andress (Author), Steve Winterfeld (Author).

M. C. A. Science (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Computer Networks
Course Code:MET-105
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Analyze the basics of data communications and network architecture.
2. Analyze functions of each layer of a computer network.
3. Evaluate essential features of specific protocols in the common protocol suite.
4. Analyze the methodology and the rationale behind addressing, routing, and congestioncontrol.
5. Understand various multiplexing and switching methods used in networks.
6. Compare and contrast symmetric and asymmetric encryption systems and theirvulnerability to attack, and explain the characteristics of hybrid systems.
7. Identify some of the factors driving the need for network security

UNIT-I (15 Hours)
Data communication-analog and digital signal transmission, Data transmission-serial and parallel transmission, communication and transmission modes (synchronous, asynchronous), error control(forward, backward) error detection(parity, block sum check, CRC), transmission media (twisted pair, coaxial cable, optical fibers), unguided transmission media(radio waves, microwaves, infrared), classification of computer network- geographical spread (LAN,WAN, MAN), topology- (bus, star, ring, mesh, tree), ownership (private, public, VAN), switching circuit, packet, message and routing, multiplexing-FDM,TDM, concentrator, components of computer networks-files server, workstation, network interface unit, transmission media, hub, repeater, bridge, router, gateway, mode. Case study- Prepare/ present report on network components used in any selected organization/Institute/Company.

UNIT-II (15 Hours)
Data Link Layer: Error detection and control code- Error Control -Hamming Code and CRC Flow Control -Stop and Wait protocol, sliding window protocol, Random Access Protocols - ALOHA – pure and slotted. Network Layer: Store-and-forward packet switching, Services Provided to the Transport Layer, Implementation of Connectionless and Connection Oriented Service, concept of routing, optimality principle, routing algorithms-shortest path, distance vector, link state, hierarchical, broadcast, multicasting. Congestion control & congestion control algorithm.

UNIT-III (15 Hours)
Transport Layer- Introduction, transport service primitives, multiplexing, UDP, TCP. Application Layer-Domain name system (DNS), Telnet, File transfer protocol (FTP), Simplemail transport protocol (SMTP), Hyper text transfer protocol (HTTP), Network file system (NFS).

UNIT-IV (15 Hours)
Network Security- Introduction, concept of cryptography, authentication protocols, firewall, virtual private networks (VPN), wireless security, email security, web security- SSL. Case Study – Implementation of LAN, Configuration of various connecting devices.

References:

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

M. C. A. Science (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Computer Architecture
Course Code:MET-106
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the basic components and organization of a computer system.
2. Gain knowledge of the fundamental principles of computer architecture.
3. Learn the different instruction set architectures (ISAs) and their impact on system performance.
4. Understand memory systems, including cache organization and virtual memory.
5. Study input/output (I/O) devices and their interaction with the system.
6. Learn about the role and design of system buses and interconnects.

Unit –I **(15 Hours)**
Introduction to computer architecture: basic concepts and components, Von Neumann architecture and its limitations, Functional Units, Basic Operational Concepts, Performance, Instructions: Language of the Computer, Operations, Operands, Instruction representation, Logical operations, decision making, MIPS Addressing, Instruction set architecture (ISA) and its importance, Performance metrics and measurement techniques in computer architecture, Instruction-level parallelism (ILP) and its impact on performance

Unit-II **(15 Hours)**
Pipelining: principles and challenges, Pipeline hazards and techniques for their resolution, Superscalar and out-of-order execution techniques, Branch prediction and control flow handling, Memory hierarchy: cache organization and principles, Cache mapping techniques and replacement policies, Virtual memory, paging, and address translation, TLB (Translation Lookaside Buffer) and its role in virtual memory

Unit-III **(15 Hours)**
Input/output (I/O) devices and controllers, I/O interfaces and protocols, System buses and interconnects, Bus protocols and arbitration techniques, Parallel processing: principles and classifications, SIMD and MIMD architectures, Introduction to multiprocessor and multicore architectures, Cache coherence protocols in multiprocessor systems, Performance evaluation and benchmarking of computer architectures

Unit -IV **(15 Hours)**
Memory Hierarchy, memory technologies, cache memory, measuring and improving cache performance, virtual memory, TLBs, Accessing I/O Devices, Interrupts, Direct Memory Access, Bus structure, Bus operation, Arbitration, Interface circuits, A Basic MIPS implementation, Building a Datapath, Control Implementation Scheme, Pipelining, Pipelined datapath and control, Handling Data Hazards & Control Hazards

References

1. Computer Fundamentals Architecture and Organization by Ram B
2. Fundamental of Computer Organization and Design by Sivarama P Dandamudi
3. Fundamentals of Computer Organization and Architecture by Jyotsna Sengupta
4. Computer System Architecture by M Morris R Mano
5. Computer Organization and Design: The Hardware/Software Interface by David A Patterson and John L Hennessy

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

Title of Course: Advanced Operating System
Course Code:MMT-201
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

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

Unit-I **(15 Hours)**
Overview of operating system design principles, Historical perspective and evolution of operating systems, Challenges in modern operating systems, Basics of process scheduling, Scheduling algorithms: FCFS, SJF, Round Robin, Priority Scheduling, Multilevel feedback queues and lottery scheduling, Real-time scheduling algorithms, Address spaces and memory hierarchy, Paging and segmentation, Virtual memory management, Page replacement algorithms, Memory allocation and de-allocation

Unit-II **(15 Hours)**
Multiprocessor Operating Systems: System Architectures- Structures of OS , OS design issues, Process synchronization, Process Scheduling and Allocation- memory management, Distributed Operating Systems: System Architectures, Design issues, Communication models, clock synchronization, mutual exclusion, election algorithms, Distributed Deadlock detection, Distributed scheduling - Distributed shared memory, Distributed File system , Multimedia file systems, File placement, Caching

Unit-III **(15 Hours)**
File system design principles, File organization and access methods, File system implementation techniques, Directory structures and file metadata, File system reliability and recovery, Introduction to distributed systems, Networked file systems, Distributed process management, Distributed synchronization and consistency, Distributed fault tolerance and recovery, Threat models and security principles, User authentication and access control, Secure communication and encryption, Security vulnerabilities and countermeasures, Intrusion detection and prevention

Unit-IV **(15 Hours)**
Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms, Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management

References

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

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

Title of Course: Java Programming
Course Code:MMT-202
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. Develop Java client/server applications.
4. Understand distributed applications using RMI
5. Understand Spring and Spring Boot Framework.

Unit -I **(15 Hours)**
Introduction: Architecture and its components, Introduction to java programming environment: Java Class File, Java Runtime Environment, The Java Virtual Machine(JVM), JVM Components, The Java API, java platform, java development kit , java compiler, java interpreter, Understanding Class path, Features of Java, Byte Code, Control Flow Statements: The If…Else If… Else Statement, the Switch…Case Statement , Iterations: The While Loop, The Do … While Loop, The For Loop, The For each Loop, Labelled Statements, The Break And Continue Statements.

Unit -II **(15 Hours)**
OOP in Java ,Objects and classes, Inheritance, Polymorphism , Interfaces, inner classes, Constructor, Garbage collector , Method Overloading Method Overriding, this key word, super keyword, Packages., data types in java primitive data type and non primitive data type. Introduction: Comments, Types of comments. Classes: Types of Classes, Scope Rules, Access Modifier. Introduction to Java Utility classes and collection classes Date, DateFormat and Gregorian calendar classes.java package, A Simple Java Program, Object Creation, Using Java.lang. Object class in program, programs using inheritance, using packages in java program.

Unit -III **(15 Hours)**
Java Servlets: Servlet basics, servlet life cycle , Generic and HTTP servlets, The Servlet API, javax.servlet and javax.servlet.http package, session tracking using session and cookies, web deployment descriptor, web.xml. Remote Method Invocation–Introduction, architecture, defining remote objects, creating stubs and skeleton, object serialization, dynamically loaded classes, RMI activation, registering remote objects, marshaled objects. Java Server Pages (JSP): Introduction to JSP tags and directive, Request String, User Sessions, Cookies, Session objects.

Unit-IV **(15 Hours)**
Java Database Connectivity, JDBC overview, Architecture, Types of JDBC Drivers, Driver Manager class, database connection statements, Resultset, transaction, Metadata and Aggregate functions , callable statements, Connection to various back ends. Spring and Hibernate: Spring API libraries, Introduction to Spring Boot, Features of Spring Boot Spring Boot Architecture.

References

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

M. C. A. Science (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 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 understand and implement Java programming environment.
2. Develop Java client/server applications.
3. Develop ASP.NET application
4. Utilize SQL Server with ASP.NET

Practical's will be based on MMT-202 and MMT-204

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

Title of Course: Web Technology
Course Code:MMT-204
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. Develop ASP.NET application
3. Utilize SQL Server with ASP.NET

Unit -I **(15 Hours)**
ASP.NET Introduction, First ASP.NET Application, Page Life cycle, various server controls, Validation controls, State management, caching, Web services, Introduction to AJAX, AJAX Extenders, ADO.NET Overview, ADO.NET architecture, .NET Data Providers, Data Controls And Data Binding, Navigating between Pages, Using SiteMapPath, Using TreeView, Using Menu

Unit-II **(15 Hours)**
Implementation of DDL, DML command with ASP.NET application, Creating Tables and Relationships and constraints, SQL Fundamentals, Stored Procedures, views, joins, subqueries, MasterPages

References

1. Web Application Development : Asp.Net with C# by Himali Patel
2. Beginning ASP.NET for Visual Studio 2015 by William Penberthy

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

Title of Course: Network Security
Course Code:MET-205
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the fundamental principles of access control models and techniques, authentication and secure system design.
2. Understand the basics of cryptography and encryption systems.
3. Understand principles and practice of different encryption techniques.
4. Identify and mitigate different network security systems

Unit- I **(15 Hours)**
Introduction of Network Security: Introduction, need of network security, web security, Security attacks-active attacks, passive attacks, intrusion detection system, firewall, concept of cryptography, OSI security architecture Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory product cryptosystem – cryptanalysis.

Unit- II **(15 hrs)**
Symmetric Key Cryptography: Mathematics Of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic-Euclid's algorithm- Congruence and matrices -Groups, Rings, Fields- Finite fields- Symmetric Key Ciphers: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation Evaluation criteria for AES – Advanced Encryption Standard – RC4 – Key distribution.

Unit- III **(15 Hours)**
Public Key Cryptography: Mathematics Of Symmetric Key Cryptography: Primes – Primality Testing –Factorization Euler‘s totient function, ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

Unit- IV **(15 Hours)**
Message Authentication and Integrity Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols-Authentication applications – Kerberos, X.509

Reference Books:

1. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security, Second Edition, Private Communication in Public World", PHI 2002.
2. Tony Bradley, "Essential Computer Security: Everyone's Guide to Email, Internet and Wireless security", Syngress Publication 2006
3. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill, 2007. 4. Information & Network Security for GTU, I. A. Dhotre V. S. Bagad, Technical Publication, Edition 2018
4. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
5. Cryptography and Network Security Principles and Practice Fourth Edition, William Stallings, Pearson Education

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

Title of Course: Software Engineering
Course Code:MET-206
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

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

UNIT-I **(15 Hours)**
Introduction to Software Engineering: Software definition, characteristics, software application domains, unique nature of web apps, seven principles of software engineering, software development process, Waterfall Model, prototyping, spiral model, Concurrent Models, The Formal Methods Model, 12 Principles of Agility, Extreme Programming (XP), Scrum process flow, Selection of Software Process models.

UNIT -II **(15 Hours)**
Requirements Engineering and Design Concepts: Seven tasks of requirement engineering, Eliciting Requirements, Types of requirement, fundamental problem in defining requirements, SRS template. Translating the requirement model into the design model, software design concepts- abstraction, architecture, pattern, separation of concerns, modularity, information hiding, functional independence-cohesion, coupling, refinement, aspects, refactoring.

UNIT -III **(15 Hours)**
Introduction to UML: The design model: Developing use cases, Relationships, class diagrams, associations, generalizations, object diagram, Dynamic modeling – State diagrams, Sequence diagrams, Collaboration diagrams, Activity diagrams etc. Logical and physical architecture – Component diagram, Deployment diagrams etc. Case Studies: Courseware management system, ATM, Airline reservation System

UNIT-IV **(15 Hours)**
Introduction to Testing: A Strategic Approach to Software Testing, Strategic Issues, Unit testing, Integration testing, Validation Testing, System Testing, Black box testing and white box testing, The Art of Debugging. Testing web applications- testing strategy, testing process, content testing, user interface testing, navigation testing, configuration testing, security testing, performance testing. Study of software testing tool.

References:

1. Software Engineering by Roger Pressman. 7th edition.
2. Software Engineering for students: A Programming Approach by Douglas Bell, Pearson publication.
3. Software Engineering Sommer ville 8th edition.
4. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson Addison Wesley 2005.
5. UML A Beginners Guide Jason T. Roff McGraw Hill Professional.
6. Learning UML 2. 0 Kim Hamilton, Russ Miles O'Reilly Media 2006.

7. Software Quality Engineering by Jeff Tian.
8. Software Testing And Quality Assurance Theory And Practice By Kshirasagar Naik, Priyadarshi Tripathy
9. The art of software testing by GJ Myers, Wiley
10. Software Testing: Principles and Practices by Srinivasan D and Gopalswamy R, Pearson Ed, 2006
11. Software Testing Foundations, Andreas Spillner, Tilo Linz, Hans Schaefer, Shoff Publishers and Distributors

M. C. A. Science (Part I) (Level-6.0) (Semester II)
(NEP-2020)
(Introduced from Academic Year 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 suppose to carry out on job training during his/her semester vacation.

9. Scheme of Teaching

1. Each contact session for teaching or practical should be of 60 minutes each.
2. Minimum 45 periods should be conducted for each subject of 80 Marks.
3. One Practical Batch should be of 30 students.
4. Practical evaluation should be conducted before the commencement of University examination

10. Examination Pattern

Theory:

- **For 4 credit course-** University examinations: 80 marks, Internal evaluation: 20 marks
    - Two tests should be conducted of MCQ type questions. Each test will be of 10 marks
- **For 2 credit course-** University examinations: 40 marks, Internal evaluation: 10 marks
    - One test should be conducted of MCQ type questions of 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 one external and one internal examiner.

On Job Training:

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

Research Project:

- **For 4 credit course-** University examinations: 80 marks, Internal evaluation: 20 marks
    - Project viva by university appointed external and internal examiners.
    - Internal evaluation will be carried out by internal guide.
- **For 6 credit course-** University examinations: 100 marks, Internal evaluation: 50 marks
    - Project viva by university appointed external and internal examiners.
    - Internal evaluation will be carried out by internal guide.

Research Methodology:

- University examinations: 80 marks, Internal evaluation: 20 marks
    - Two tests should be conducted of MCQ type questions. Each test will be of 10 marks

11. Nature of Question Paper and Scheme of Marking

Theory:

1) There will be seven (7) questions of 16 Marks and out of which four (4) to be attempted from question no 2 to 6.

2) Question No.1 is compulsory and is of multiple choice questions. There will be 8 multiple choice question each carries 2 marks

3) Question No.2 to Question No. 6 should consist 2 sub question each carries 8 marks

4) Question No. 7 should be a short note, where 4 questions will be given, out of which two questions should be attempted

Practical:

1) Duration of Practical Examination: 3 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 panel external and internal examiners. He has to submit the report of work carried out as part of On Job Training.

Research Project:

- Student has to identify research problem in the semester-III and have to carry out thorough literature review / student can develop a application project which will address societal issues.

- Student have to design a model and implement for the research problem identified in semester-III / student can carry out a project which will address societal issues.
- It is preferable to publish the research work carried out in the form of Seminar/ Workshop/ Conference proceedings /Research journal publications.

12. Equivalence of courses

M. C. A. 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	Computer Organization	4	**MET-106**	Computer Architecture	4
I	CC-102	Operating System	4	**MMT-201**	Advanced operating system	4
I	CC-103	Python Programming	4	---	***No equivalence**	
I	CC-104	Database Management System	4	**MMT-102**	Database Manage ment System	4
I	CC-105	Mathematical Foundations	4	---	***No equivalence**	4
II	CC-201	Design and Analysis of Algorithms	4	**MMT-101**	Advanced Data Structures	4
II	CC-202	Web Technology	4	---	***No equivalence**	4
II	CC-203	Software Engineering	4	**MET-206**	Software Engineering	4
II	CC-204	Java Programming	4	**MMT-202**	Java Program ming	4
II	CC-205	Computer Oriented Numerical Methods	4	---	***No equivalence**	4

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

M. C. A. Part II (Semester III and IV)

Old Course				Equivalent Course		
Sem No.	**Course Code**	**Title of Old Course**	**Credit**	**Course Code**	**Title of New Course**	**Credit**
III	CC-301	Artificial Intelligence	4	**MMT-301**	Artificial Intelligence	4
III	CC-302	PHP	4	---	***No equivalence**	
III	CC-303	Computer Networks	4	MET-105	Computer Networks	4

III	CC-304.1	Cyber Security	4	---	***No equivalence**	
III	CC-304.2	Natural Language Processing	4	---	***No equivalence**	4
III	CC-304.3	Computer Graphics	4	---	***No equivalence**	
III	CC-304.4	Machine Learning	4	MET-405	**Machine Learning**	4
III	CC-304.5	Theory of Computation	4	---	***No equivalence**	
III	CC-304.6	Cloud Computing	4	**MET-305**	Cloud Computi ng	4
III	CC-305.1	Management Information System	4	---	***No equivalence**	4
III	CC-305.2	Supply Chain Management	4	---	***No equivalence**	4
III	CC-305.3	Knowledge Management	4	---	***No equivalence**	4
III	CC-305.4	Business Process Management	4	---	***No equivalence**	4
III	CC-305.5	E-Commerce	4	---	***No equivalence**	4
III	CC-305.6	Semantic Web	4	---	***No equivalence**	4
IV	CC-401	Data Science	4	**MET-306**	**Data Science**	4
IV	CC-402	Advance Web Technology	4	**MET-302**	**Front End Developmen t**	4
IV	CC-403	Android Development with Kotlin	4	**MMT-401**	**Mobile Application Developmen t**	4
IV	CC-404.1	Block Chain Technology	4	**MET-404**	**Block Chain Technology**	4
IV	CC-404.2	Deep Learning	4	---	***No equivalence**	4
IV	CC-404.3	Network Security	4	MET-205	Network Security	4
IV	CC-404.4	Optimization Techniques	4	---	***No equivalence**	4

IV	CC-404.5	Robotics	4	---	***No equivalence**	4
IV	CC-404.6	Internet of Things	4	---	***No equivalence**	4
IV	CC-405.1	Business Intelligence	4	---	***No equivalence**	4
IV	CC-405.2	Enterprise Resource Planning	4	---	***No equivalence**	4
IV	CC-405.3	Human Resource Management	4	---	***No equivalence**	4
IV	CC-405.4	Big Data Analytics	4	---	***No equivalence**	4
IV	CC-405.5	Social Media Management	4	---	***No equivalence**	4
IV	CC-405.6	Web Mining	4	---	***No equivalence**	4

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