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MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)
Pimpri Chinchwad Education Trust's

Pimpri Chinchwad University

Sate, Maval, Pune - 412106



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Curriculum Structure

Master Of Computer Applications (M.C.A)

(2026 Pattern)

Choice-Based Credit System (CBCS)

School of Computer Applications



Effective from Academic Year 2026-27





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MCA CURRICULUM STRUCTURE 2026 Pattern (AS PER NEP 2020)

Program Curriculum

Preamble:

At Pimpri Chinchwad University, we present the Master of Computer Application (MCA), a post-graduate program designed to equip students with a comprehensive understanding of Computer Science and Application. As aspiring professionals in the field of computing, we acknowledge the weight of responsibility that accompanies our education. Upholding the highest standards of integrity, professionalism, and ethical conduct is fundamental to our academic pursuits and beyond. We embrace the imperative of continuous learning and adaptability in an era marked by rapid technological advancement, pledging to proactively seek new knowledge and master emerging technologies.

The MCA program curriculum is designed to provide students with a strong foundation in computer science, programming languages, software engineering, database management systems, and computer networks. The program also includes courses on business management and soft skills to prepare students for a career in the IT industry.

Overall, an MCA program aims to provide students with a well-rounded education that prepares them for a successful career in the IT industry and for further academic pursuits.

Vision and Mission of the Program:

Vision:

To create computer application specialists who will benefit society, industry, and all stakeholders.

Mission:

To provide people in the computer application sector with valuable academic, research, and employment prospects as well as social consciousness with ethical principles.



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Program Outcomes:

Here are some possible Program Outcomes (POs) for a Master of Computer Application (MCA) program:

1. Computational Knowledge: Understand and apply mathematical foundations, computing, and domain knowledge for the conceptualization of computing models from defined problems.
2. Problem Analysis: Ability to identify, critically analyses, and formulate complex computing problems using fundamentals of computer science and application domains.
3. Design and Development of Solutions: Ability to transform complex business scenarios and contemporary issues into problems, investigate, understand, and propose integrated solutions using emerging technologies.
4. Conduct Investigations of Complex Computing Problems: Ability to devise and conduct experiments, interpret data, and provide well-informed conclusions.
5. Modern Tool Usage: Ability to select modern computing tools, skills, and techniques necessary for innovative software solutions
6. Professional Ethics: Ability to apply and commit to professional ethics and cyber regulations in a global economic environment.
7. Life-long Learning: Recognize the need for and develop the ability to engage in continuous learning as a Computing professional.
8. Project Management: Ability to understand management and computing principles with computing knowledge to manage projects in multidisciplinary environments.
9. Communication Efficacy: Communicate effectively with the computing community as well as society by being able to comprehend effective documentation and presentations.
10. Societal & Environmental Concern: Ability to recognize economic, environmental, social, health, legal, and ethical issues involved in the use of computer technology and other consequential responsibilities relevant to professional practice.
11. Individual & Team Work: Ability to work as a member or leader in diverse teams in a multidisciplinary environment.
12. Innovation and Entrepreneurship: Identify opportunities, entrepreneurship vision, and use of innovative ideas to create value and wealth for the betterment of the individual and society.

Program Educational Objectives:

Here are some possible Program Educational Objectives (PEOs) for a Master of Computer Applications (MCA) program:

To prepare the youth to take up positions as system analysts, system engineers, software engineers, and Programmers.

1. To aim at developing systems thinking, abstract thinking, skills to analyze and synthesize, and skills to apply knowledge through extensive problem-solving sessions, hands-on practice under various hardware and software environments, and projects developed.
2. To prepare students with social interaction skills, communication skills, life skills, entrepreneurial skills, and research skills, which are necessary for career growth and for leading a quality life.

Program Specific Outcomes:



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PSO1-- Comprehend and implement mathematical and industrial principles in computing methodologies to address real-time industrial issues.

PSO2:-Utilizing the most recent computer tools and technologies, analyze, design, develop, test, and maintain software applications.

PSO3: the capacity to employ computer technology and mathematical and computer science skills to solve business difficulties



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MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)
INDEX

Sr. No.	Content	Pg. No.
1	Curriculum Framework	07
2	Course Code Nomenclature	09
3	Credit Distribution	08
4	Course Structure	10-15
5	Relational Database Management System	17-19
6	Data Structures and Algorithms Using C++	20-22
7	Data Communication And Networking	23-25
8	Software Testing & Software Project Management	26-27
9	Operating System	28-31
10	Mathematical And Computational Thinking And Analysis	32-34
11	Effective Written Communication	35-36
12	Research Methodology	37-39
13	Introduction to Object-Oriented Programming(C++ / Java)	40-42
14	Foreign Language I-1: German	43-44
15	Foreign Language I-2: Japanese	45-46
16	Foreign Language I-3: Korean	
17	Relational Database Management System Lab	47-49
18	Data Structures and Algorithms Using C++ Lab	50-51
19	Advance Java Programming	53-54
20	Advanced Web Technology	55-57
21	Applied Reasoning and Problem Solving	





**MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)**

22	An Introduction to Artificial Intelligence	58-60
23	Advance Java Programming Lab	61-62
24	Advanced Web Technology Lab	63-64
25	Foreign Language II-1: German	65-66
26	Foreign Language II-2: Japanese	67-69
27	Foreign Language II-3: Korean	
28	DevOps	
29	Machine Learning Using python	
30	Big Data Analytics	
31	Data Analysis using Power BI	
32	Mobile App Development (Android)	
33	Mini Project	
34	Full Stack Application Development using MERN	
35	Cloud Computing	
36	Rural Immersion (Digital literacy programs / Sustainable Development & Environment (Rural) / Field Work & Rural Internship)	
37	DevOps Lab	
38	Machine Learning Using python Lab	
39	-	-
40	-	-
	-	-
	-	-
	-	-



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MCA CURRICULUM STRUCTURE
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CURRICULUM FRAMEWORK

Sr. No.	Type of course	Abbreviations
1	Discipline Specific Courses (Major)	DSC
2	Major Elective	DSE
3	Ability Enhancement Courses	AEC
4	Skill Enhancement Courses(MOOC)	SEC
5	Summer Internship and On Job Training	OJT
6	Field Project	FP
7	Value Added Course	VAC
8	Online Courses	MOOC



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**MCA CURRICULUM STRUCTURE
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Sr. No.	Type of Course	Abbreviation	No. of Courses	Total Credits	Percentage (%)
1	Discipline Specific Courses (Major)	DSC	15	35	40 %
2	Major Elective	DSE	3	9	10.23 %
3	Ability Enhancement Courses	AEC	6	6	6.82 %
4	Skill Enhancement Courses (MOOC)	SEC	7	14	15.91 %
5	Summer Internship & On Job Training/Field Project	OJT/FP	3	16	18.19 %
6	Value Added Course	VAC	3	7	7.95 %
7	Online Courses	MOOC	3	7	7.95 %
	Total	—	35	88	100

CREDIT DISTRIBUTION: SEMESTER WISE

Sr. No.	Type of course	No. of Credits and Semester				Total
		1	2	3	4	
1	Major	Max:13 Min:10	Max:13 Min:10	Max:10 Min:10	Max:10 Min:10	35
2	Major Elective	Max:3 Min:0	Max:3 Min:0	Max:3 Min:3	-	9
3	Ability Enhancement Courses	Max:3 Min:0	Max:3 Min:0	Max:2 Min:2	-	7
4	Skill Enhancement Courses(MOOC)	Max:3 Min:0	Max:3 Min:0	Max:3 Min:3	-	6
5	MOOC Courses	Max:2 Min:2	Max:3 Min:3	Max:2 Min:2	-	7
6	Summer Internship & On-Job Training/Field Project	-	Max:2 Min:2	Max:2 Min:2	Max:12 Min:12	16
7	Value Education Course (Audit Courses)	Max:3 Min:3	-	-	-	6
		22	22	22	22	88



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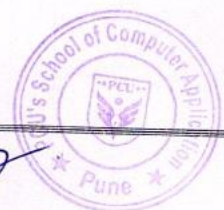
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MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)
COURSE CODE NOMENCLATURE

FIELD ABBREVIATIONS

Sr. No.	Field Name	Abbreviations
1	THEORY	TH
2	PRACTICAL	PR
3	TUTORIAL	TUT
4	ORAL	OR
5	HOURS	HR
6	CONTINUOUS INTERNAL ASSESSMENT	CIA
7	END SEMESTER ASSESSMENT	ESA



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PIMPRI CHINCHWAD UNIVERSITY, PUNE, MAHARASHTRA												
SCHOOL OF COMPUTER APPLICATIONS												
PROGRAM STRUCTURE												
MASTER OF COMPUTER APPLICATIONS (M.C.A.) 2026 PATTERN												
Effective from the Academic Year (2026-2027)												
SEMESTER – I												
COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME						ASSESSMENT SCHEME			
			TH	PR	TUT	CRED IT	HRS		CIA	ESA	PR /OR	TOTAL
PM26MCCA101	DSC	Relational Database Management System	3	-	-	3	3		40	60	-	100
PM26MCCA102	DSC	Data Structures and Algorithms Using C++	3	-	-	3	3		40	60	-	100
PM26MCCA103	* DSC (CBCS I)	Data Communication And Networking	3	-	-	0-3	3		40	60	-	100
PM26MCCA104	DSE (CBCS I)	Domain Specific Elective - I	3	-	-	0-3	3		40	60	-	100
PM26MCCA105A	* SEC (CBCS II)	Mathematical And Computational Thinking And Analysis	3	-	-	0-3	3		40	60	-	100
PM26MCCA105B	AEC (CBCS II)	Effective Written Communication	3	-	-	0-3	3		40	60	-	100
PM26MCCA106	VAC	Research Methodology	3	-	-	3	3		40	60	-	100
PM26MCCA107	MOOC	Introduction to Object-Oriented Programming(C++ / Java) (MOOC)	2			2	2		20	30		50
	AEC	Foreign Language - I	1	-	-	1	2		50	-	-	50
PM26MCCA111	DSC	Relational Database Management System Lab	-	2	-	2	4		25		25	50
PM26MCCA112	DSC	Data Structures and Algorithms Using C++ Lab	-	2	-	2	4		25		25	50
TOTAL			22	4	0	22	27		320	330	50	700
PM26MCCA108 FOREIGN LANGUAGE – I												
	AEC	Foreign Language-1: German	2	-	-	1	2		50		-	50
	AEC	Foreign Language-2: Japanese	2	-	-	1	2		50		-	50
	AEC	Foreign Language-3: Korean	2	-	-	1	2		50		-	50
PM26MCCA104 DOMAIN SPECIFIC ELECTIVE – I												
PM26MCCA104A	DSE	Software Testing & Software Project Management	3	-	-	3	3		40	60	-	100
PM26MCCA104B	DSE	Operating System	3	-	-	3	3		40	60	-	100

*** Note:**

- Students can opt for any one course from CBCS I and CBCS II in Semester I or Semester II under the Choice Based Credit System (CBCS).
- Students undertaking full-time internships shall complete the prescribed theory courses through online platforms such as SWAYAM / NPTEL / COURSERA



**MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)**

PIMPRI CHINCHWAD UNIVERSITY, PUNE, MAHARASHTRA												
SCHOOL OF COMPUTER APPLICATIONS												
PROGRAM STRUCTURE												
MASTER OF COMPUTER APPLICATIONS (M.C.A.) 2026 PATTERN												
Effective from the Academic Year (2026-2027)												
SEMESTER – II												
COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME						ASSESSMENT SCHEME			
			TH	PR	TUT	CRED IT	HRS		CIA	ESA	PR /OR	TOTAL
PM26MCCA201	DSC	Advanced Java Programming	3	-	-	3	3		40	60	-	100
PM26MCCA202	DSC	Advanced Web Technology	3	-	-	3	3		40	60	-	100
PM26MCCA103	* DSC (CBCS I)	Data Communication And Networking	3	-	-	0-3	3		40	60	-	100
PM26MCCA104	DSE (CBCS I)	Domain Specific Elective - I	3	-	-	0-3	3		40	60	-	100
PM26MCCA205	FP	Mini Project	-	2	-	2	4		50		50	100
PM26MCCA105A	* SEC (CBCS II)	Mathematical and Computational Thinking And Analysis	3	-	-	0-3	3		40	60	-	100
PM26MCCA105B	AEC (CBCS II)	Effective Written Communication	3	-	-	0-3	3		40	60	-	100
PM26MCCA206	VAC	Applied Reasoning and Problem Solving	-	2		2	4		50	-	-	50
PM26MCCA207	MOOC	An Introduction to Artificial Intelligence (MOOC)	3			3	3		20	30	-	50
	AEC	Foreign Language - II	2	-	-	1	2		50	-	-	50
PM26MCCA211	DSC	Advanced Java Programming Lab	-	1	-	1	2		25		25	50
PM26MCCA212	DSC	Advanced Web Technology Lab	-	1	-	1	2		25		25	50
TOTAL			17	6	0	22	29		380	270	100	750
PM26MCCA208 FOREIGN LANGUAGE – II												
	AEC	Foreign Language-1: German	2	-	-	1	2		50		-	50
	AEC	Foreign Language-2: Japanese	2	-	-	1	2		50		-	50
	AEC	Foreign Language-3: Korean	2	-	-	1	2		50		-	50
PM26MCCA104 DOMAIN SPECIFIC ELECTIVE – I												
PM26MCCA104A	DSE	Software Testing & Project Management	3	-	-	3	3		40	60	-	100
PM26MCCA104B	DSE	Operating System	3	-	-	3	3		40	60	-	100

***Note:**

1. Students can opt for any one course from CBCS I and CBCS II in Semester I or Semester II under the Choice Based Credit System (CBCS).

2. Students undertaking full-time internships shall complete the prescribed theory courses through online platforms such as SWAYAM or NPTEL



MCA CURRICULUM STRUCTURE 2026 Pattern (AS PER NEP 2020)

Exit Policy

Exit Policy: PG Diploma in MCA: Students who opt to exit after completion of the first year and have scored the required credits offered by the school in the program structure will be awarded a PG Diploma in MCA, provided they must earn additional credits during the summer vacation of the first year

COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME					ASSESSMENT SCHEME			
			TH	PR	TUT	CREDIT	Hrs	CIA	ESA	PR/OR	TOTAL
PDIEXMC101	VSC	Information security / MOOCs	2	-	-	2	2	25		25	50
PDIEXMC102	VSC	Project	-	4	-	4	8	50	-	50	100



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2026 Pattern (AS PER NEP 2020)**

PIMPRI CHINCHWAD UNIVERSITY, PUNE, MAHARASHTRA												
SCHOOL OF COMPUTER APPLICATIONS												
PROGRAM STRUCTURE												
MASTER OF COMPUTER APPLICATIONS (M.C.A.) 2026 PATTERN												
Effective from the Academic Year (2026-2027)												
SEMESTER – III												
COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME					ASSESSMENT SCHEME				
			TH	PR	TUT	CREDIT	HRS		CIA	ESA	PR /OR	TOTAL
PM26MCCA301	DSC	DevOps	3	-	-	3	3		40	60	-	100
PM26MCCA302	DSC	Machine Learning Using python	3	-	-	3	3		40	60	-	100
PM26MCCA303	DSC	Big Data Analytics	2	-	-	2	2		20	30	-	50
PM26MCCA304	DSE	DOMAIN ELECTIVE – II	2	-	1	3	4		40	60	-	100
PM26MCCA301	FP	Mini Project	-	2	-	2	4		50	-	50	100
PM26MCCA301	SEC	Full Stack Application Development using MERN	3	-	-	3	3		40	60	-	100
PM26MCCA301	MOOC	Cloud Computing (MOOC)	2	-	-	2	2		20	30	-	50
PM26MCCA301	AEC	Rural Immersion (Digital literacy programs / Sustainable Development & Environment (Rural) / Field Work & Rural Internship)		2	-	2	2		50		-	50
PM26MCCA311	DSC	DevOps Lab	-	1	-	1	2		25		25	50
PM26MCCA312	DSC	Machine Learning Using python Lab	-	1	-	1	2		25		25	50
TOTAL			15	6	1	22	27		350	300	100	750
PM26MCCA304 DOMAIN ELECTIVE – II												
PM26MCCA304A	DSE	Data Analysis using Power BI	2	-	1	3	4		40	60	-	100
PM26MCCA301B	DSE	Mobile App Development (Android)	2	-	1	3	4		40	60	-	100

NOTE:-

Students undertaking full-time internships shall complete the prescribed theory courses through online platforms such as SWAYAM or NPTEL



**MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)**

(Scheme A For On-Campus Students)

PIMPRI CHINCHWAD UNIVERSITY, PUNE, MAHARASHTRA											
SCHOOL OF COMPUTER APPLICATIONS											
PROGRAM STRUCTURE											
MASTER OF COMPUTER APPLICATIONS (M.C.A.) 2026 PATTERN											
Effective from the Academic Year (2026-2027)											
SEMESTER – IV											
COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME					ASSESSMENT SCHEME			
			TH	PR	TUT	CREDIT	HRS	CIA	ESA	PR / OR	TOTAL
PM26MCCA401	DSC	Blockchain	3	-	-	3	3	40	60	-	100
PM26MCCA402	DSC	Quantum Computing	3	-	-	3	3	40	60	-	100
PM26MCCA403	MOOC	Linux and Git For Open Source Software Development(MOOC)	2	-	-	2	2	20	30	-	50
PM26MCCA404	VAC	Seminar/Workshop	2	-	-	2	2	50	-	-	50
PM26MCCA405	OJT	Major Project / Research Project / Internship	-	12	-	12	-	250	-	250	500
TOTAL			10	12	0	22	10	400	150	250	800





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**MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)
(Scheme A For On-Campus Students)**

***(Scheme B For Full-Time Internship Students)**

PIMPRI CHINCHWAD UNIVERSITY, PUNE, MAHARASHTRA												
SCHOOL OF COMPUTER APPLICATIONS												
PROGRAM STRUCTURE												
MASTER OF COMPUTER APPLICATIONS (M.C.A.) 2026 PATTERN												
Effective from the Academic Year (2026-2027)												
SEMESTER – IV												
COURSE CODE	COURSE TYPE	COURSE NAME	TEACHING SCHEME					ASSESSMENT SCHEME				
			TH	PR	TUT	CREDIT	HRS	CIA	ESA	PR / OR	TOTAL	
PM26MCCA401	DSC	Blockchain (MOOC)	3	-	-	3	3	40	60	-	100	
PM26MCCA402	DSC	Quantum Computing (MOOC)	3	-	-	3	3	40	60	-	100	
PM26MCCA403	MOOC	Linux and Git For Open Source Software Development (MOOC)	2	-	-	2	2	20	30	-	50	
PM26MCCA404	VAC	Seminar/Workshop	2	-	-	2	2	50	-	-	50	
PM26MCCA405	OJT	Major Project / Research Project / Internship	-	12	-	12	-	250	-	250	500	
TOTAL			10	12	0	22	10	400	150	250	800	

***Note:-** Students undertaking full-time internships shall complete the prescribed theory courses through online platforms such as SWAYAM / NPTEL / COURSERA





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SEMISTER I





MCA CURRICULUM STRUCTURE 2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM

Name of the Program:		MCA		Semester: I		Level: PG	
Course Name		Relational Database Management System		Course Code and Course Type		PM26MCCA101 / DSC	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	45	40	60	-
Prerequisite: knowledge of DBMS Concepts							

Prerequisite: knowledge of DBMS Concepts

Course Objectives (CO):

The objectives of the Relational Database Management System

1. To familiarize students with basic concepts, architecture, and functionalities of database systems and their role in managing and organizing data efficiently.
2. To enable students to design database structures using conceptual, logical, and physical models, with emphasis on Entity-Relationship (ER) diagrams and its extended features.
3. To provide practical knowledge and expertise in writing SQL queries for data definition, manipulation, and retrieval in relational database systems.
4. To teach students to create optimized database designs that ensure data integrity, reduce redundancy, enhance performance by using Normalization techniques and to explore programming techniques in PL/SQL.
5. To introduce students to NoSQL systems and their emerging trends in database technologies.

Course Learning Outcomes (CLO):

Students will be able to:

1. To Recall and list the fundamental concepts of database systems, including their characteristics, architectures, classifications, and emerging trends.
2. To explain and interpret high-level conceptual data models, ER diagrams with relationships and constraints and relational algebra operations to demonstrate comprehension of database design and query formulation.
3. To apply relational schema design steps, database constraints, including keys and nullability, to construct normalized relational schemas.
4. To analyses transaction processing concepts, locking protocols and recovery techniques.
5. To create and implement robust database security frameworks by designing access control policies, integrating authentication and authorization mechanisms.





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2026 Pattern (AS PER NEP 2020)**Course Contents and Syllabus:**

Descriptors and Topics	CLO	Hours
UNIT I		
INTRODUCTION: Introduction to Database Systems, Characteristics of the Database Approach, Database Users, Advantages and limitations of DBMS, Data models, schemas, and instances, Three-schema architecture and data independence, Centralized database architecture, Client-server architecture, Classification based on data models, Emerging trends in DBMS (cloud databases, NewSQL, big data systems)	CLO 1	9
UNIT II		
ENTITY-RELATIONSHIP MODEL Using High-Level Conceptual Data Models for Database Design, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types; Refining the ER Design; ER Diagrams, Relational Model and Relational Algebra, Relational Model Concepts; Relational Model Constraints and Relational Database Schemas, Update Operations, 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, Cases on ER to be Covered.	CLO 2	9
UNIT III		
RELATIONAL DATABASE DESIGN Design process steps for Relational Schema, Codd's Rules, Database Relationships and Constraints, Primary Key, Foreign Key, Null, Not Null, Unique, Design Guidelines for Relational Schema: Database design anomalies, Functional Dependencies, Normalization process – understanding Normal Forms based on Primary keys and converting database tables to 1NF, 2NF and 3NF. Cases to be Covered.	CLO3	9
UNIT IV		
TRANSACTION PROCESSING: Definition of transaction, ACID properties (Atomicity, Consistency, Isolation, Durability), Concurrency control, Need for concurrency control, Problems without control (lost update, dirty read, unrepeatable read, phantom read) Serializability of scheduling (conflict and view), Locking (2PL) and timestamp-based schedulers, Database recovery techniques.	CLO4	9
UNIT V		
DATABASE SECURITY & USER MANAGEMENT: Importance of database security, Threats to databases (internal vs. external), Database Access Control, Authentication methods (passwords, biometrics, multi-factor), Authorization and access rights, Role-based access control (RBAC), SQL Security Features, Encryption in Databases, Security Policies and Standards, Database Vulnerabilities & Countermeasures, Case Studies.	CLO5	9
Total Hours		45





**MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)**

Learning resources

Textbooks:

“Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw - Hill.

“Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer Science Press.

Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Reference Books:

Fundamentals of Database Systems, 5th Edition by R. Elmasri and S. Navathe, Pearson Education, “Foundations of Databases”, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

Online Resources and E-Learning Resources

edX (IBM, Harvard, Michigan)

Coursera – Databases Specialization (Stanford / IBM)

NPTEL (IITs, India)



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MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM

Name of the Program:	MCA	Semester: I	Level: PG
Course Name	Data Structures and Algorithms Using C++	Course Code and Course Type	PM26MCCA102
Course Pattern	2026	Version	1.0

Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-

Prerequisite: Basic knowledge of C++ programming, including control structures, functions, arrays, pointers, and object-oriented concepts.

Course Objectives (CO):

The objectives of Data Structures and Algorithms Using C++ are:

1. To introduce fundamental concepts of data structures and their implementation using C++.
2. To develop problem-solving skills using algorithms and complexity analysis.
3. To provide knowledge of linear data structures such as arrays, linked lists, stacks, and queues.
4. To familiarize students with non-linear data structures like trees and graphs.
5. To enable efficient searching and sorting techniques for real-world applications.

Course Learning Outcomes (CLO):

Students will be able to :

- 1 Apply basic data structures using C++.
- 2 Analyze algorithm complexity and efficiency.
- 3 Implement linear data structures (array, stack, queue, linked list).
- 4 Apply non-linear data structures (trees and graphs).
- 5 Apply searching and sorting algorithms to solve problems.





MCA CURRICULUM STRUCTURE 2026 Pattern (AS PER NEP 2020)

Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I		
Introduction: Concept and Need of Data Structure, Definition, Abstract Data Type, Types of Data Structures, Linear Data Structures, Non-Linear Data Structures, Operations on Data Structures, Traversing, Insertion, Deletion, Algorithm Definitions and Applications, Asymptotic Notations, O-Notation, Omega Notation, Theta Notation, Time Complexity, Space Complexity, Average and Worst Case Analysis, Analyzing Control Statements.	CLO 1	9
UNIT II		
Searching, Searching for an Item in a Data Set, Linear Search, Binary Search, Sorting, Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Radix Sort.	CLO 2	9
UNIT III		
Difference between Static and Dynamic Memory Allocation, Introduction to Linked List, Node, Address, Pointer, Information Field/Data Field, Next Pointer, Null Pointer, Empty List, Linear List, Circular List, Representation of Doubly Linked List, Operations on a Singly Linked List, Creating a Linked List, Inserting a New Node in a Linked List, Deleting a Node from a Linked List, Searching a Key in Linked List, Traversing a Singly Linked List, Applications of Linked List.	CLO3	9
UNIT IV		
Stack:- Introduction to Stack, Stack as an ADT, Push, Pop, Stack Overflow, Stack Underflow, Stack Implementation using an Array, Representation using a Linked List, Applications of Stack, Reversing a List, Polish Notations, Conversion of Infix to Postfix Expression, Evaluation of Postfix Expression, Recursion, Queue:- Introduction to Queue, Queue as an ADT, Queue Representation in Memory using an Array, Representation using a Linked List, Linear Queue, Circular Queue, Priority Queue, Double-Ended Queue, Queue Operations, INSERT, DELETE, Queue Full, Queue Empty, Applications of Queue.	CLO4	9
UNIT V		
Introduction to Trees, Tree, Degree of a Node, Degree of a Tree, Level of a Node, Leaf Node, Depth/Height of a Tree, In-Degree and Out-Degree, Path, Ancestor and Descendant Nodes, Tree Types and Traversal Methods, General Tree, Binary Tree, Binary Search Tree (BST), In-Order Traversal, Pre-Order Traversal, Post-Order Traversal, Expression Tree, AVL Tree, Introduction to Graph, Graph Node, Vertices, Edges, Indegree/Outdegree Graph, Directed Graph, Undirected Graph, Adjacent, Successor, Predecessor, Adjacency List, Adjacency Matrix of Directed and Undirected Graph.	CLO5	9
Total Hours		45





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Learning resources

Textbooks:

1. Mark Allen Weiss, Data Structure and Algorithm Analysis in C++, 2014, 4th Edition, Pearson Education Limited.
2. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
3. Data Structures using C & C++ -By Ten Baum Publisher – Prentice-Hall International.

Reference Books:

1. Data Structures, Algorithms, and Applications in C++ by Michael T. Goodrich, Roberto Tamassia
2. Fundamentals of Data Structures by Ellis Horowitz and Sartaz Sahn
3. Grokking Algorithms: An Illustrated Guide for Programmers by Aditya Bhargava

Online Resources and E, Learning Resources:

1. <https://github.com/Rustam-Z/data-structures-and-algorithms/tree/master/lecture%20notes>
2. <https://www.programiz.com/dsa/linked-list>
3. <https://nptel.ac.in/courses/106102064>



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COURSE CURRICULUM

Name of the Program:		MCA		Semester: I		Level: PG	
Course Name		Data Communication and Networking		Course Code and Course Type		PM26MCCA103	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-

Prerequisite: Fundamental knowledge of computer networks and basic communication systems.

Course Objectives (CO):

The objectives of Data Communication and Networking are:

1. To understand the fundamentals of data communication, networking, and modern network architectures.
2. To analyse data link layer protocols and communication mechanisms.
3. To explain protocol layering, OSI and TCP/IP models, and transport layer concepts.
4. To apply IP addressing, subnetting, and routing techniques in scalable networks.
5. To evaluate network applications and implement security mechanisms in modern networks.

Course Learning Outcomes (CLO):

Students will be able to:

1. Explain fundamentals of data communication, signals, transmission media, and emerging networking technologies like IoT and wireless systems.
2. Analyze data link layer protocols, error detection, flow control, and MAC mechanisms.
3. Compare OSI and TCP/IP models and interpret protocol behavior including transport layer services.
4. Apply IP addressing (IPv4/IPv6), subnetting, NAT, and routing protocols in real-world scenarios.
5. Evaluate network applications, cloud-based communication, and security mechanisms for secure data transmission.





MCA CURRICULUM STRUCTURE
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Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I Fundamentals of Data Communication & Modern Networks		
Data Communication: Concepts, Components, Performance Metrics (Latency, Throughput), Signal and Data Representation, Transmission Media: Guided (Twisted Pair, Coaxial, Fiber Optics), Unguided (Radio, Microwave, Satellite), Network Types: LAN, MAN, WAN, Cloud Networks, IoT Networks, Network Topologies: Bus, Star, Ring, Mesh, Multiplexing Techniques: FDM, TDM, WDM (Overview), Network Devices: Router, Switch, Hub, Gateway, Virtual Devices, Wireless Technologies: Wi-Fi 6, Bluetooth, Introduction to 5G, Overview of Ethernet Standards (Fast/Gigabit Ethernet)	CLO 1	9
UNIT II Data Link Layer & Switching		
Data Link Layer: Functions and Design Issues, Framing Techniques, Error Detection and Correction (CRC, Hamming Code – overview), Flow Control: Stop-and-Wait, Sliding Window, MAC Protocols: CSMA/CD, CSMA/CA, Ethernet Frame Structure (Modern Ethernet), Switching Concepts: Layer 2 Switching, VLAN Basics, ARP (Address Resolution Protocol), Introduction to MAC Addressing	CLO 2	9
UNIT III Network Models & Transport Layer		
Protocol Layering and Need for Layered Architecture, OSI Reference Model, TCP/IP Model, Comparison: OSI vs TCP/IP, Encapsulation and Decapsulation Process, Transport Layer Services, TCP vs UDP (Features, Use Cases), Port Addressing and Socket Concept	CLO3	9
UNIT IV Addressing, Routing & Modern Networking		
IPv4 Addressing and Subnetting (CIDR), Network Address Translation (NAT), Private and Public IP Addressing, IPv6 Addressing: Structure and Advantages, Routing Concepts and Routing Tables, Routing Protocols: RIP, OSPF, BGP (Overview), Software Defined Networking (SDN) – Introduction Access Control Lists (ACL) – Basics	CLO4	9
UNIT V		
Application Layer Protocols: HTTP/HTTPS, FTP, DNS, Email (SMTP, POP3, IMAP), Web Architecture: Static vs Dynamic Pages, Proxy Servers, Secure Communication: SSL/TLS (Handshake Overview), Cryptography: Symmetric and Asymmetric Key Encryption, Digital Signatures, Network Security Concepts: CIA Triad, Firewalls and IDS/IPS, VPN (Virtual Private Networks), Common Cyber Attacks: Phishing, DoS/DDoS (Overview), Basics of Cloud Security	CLO5	9
Total Hours		45





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Learning resources

Textbooks:

1. Andrew S. Tanenbaum – *Computer Networks*, Latest Edition
2. Kurose & Ross – *Computer Networking: A Top-Down Approach*, Latest Edition

Reference Books:

1. William Stallings – *Data and Computer Communications*
2. Behrouz A. Forouzan – *Data Communications and Networking*
3. Fred Halsall – *Data Communications, Computer Networks and Open Systems*

Online Resources and E-Learning Resources

- NPTEL Networking Courses
- Cisco Networking Academy
- GeeksforGeeks – Computer Networks
- AWS Academy / Microsoft Azure Fundamentals (Cloud Networking Basics)



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COURSE CURRICULUM

Name of the Program:	MCA	Semester: I	Level: PG
Course Name	Software Testing and Software Project Management	Course Code/ Course Type	PM26MCCA104A
Course Pattern	2026	Version	1.0
Teaching Scheme			
Assessment Scheme			
Theory	Practical	Tutorial	Total Credits
3	-	-	3
Hours			
CIA (Continuous Internal Assessment)			
ESA (End Semester Assessment)			
Practical/ Oral			
40	60	-	-

Prerequisite: Anyone can take this course with basic knowledge of English communication.

Course Objectives (CO):

The objectives of Applied Communication are:

1. To understand fundamental concepts and principles of software testing.
2. To apply various testing techniques and strategies for quality assurance.
3. To understand the principles of software project management (SPM).
4. To develop skills in project planning, scheduling, and risk management.
5. To analyze and manage software projects using modern tools and practices.

Course Learning Outcomes (CLO):

Students would be able to:

1. Explain and apply software testing methodologies and techniques.
2. Design and execute test cases and testing strategies.
3. Apply project management principles in software development.
4. Plan, schedule, and monitor software projects effectively.
5. Evaluate risks and ensure successful delivery of software projects.

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Introduction to Software Testing: Basics of Software Testing, Testing Principles, Verification vs Validation, Software Testing Life Cycle (STLC), Levels of Testing: Unit Testing, Integration Testing, System Testing, Acceptance Testing, Types of Testing: Functional Testing, Non-Functional Testing	CLO 1	9
UNIT II		
Testing Techniques & Automation: Black Box Testing Techniques: Equivalence Partitioning, Boundary Value Analysis, White Box Testing Techniques: Statement	CLO 2	9





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Coverage, Branch Coverage, Test Case Design, Defect Life Cycle, Introduction to Test Automation Tools (Selenium)		
UNIT III		
Introduction to Software Project Management: Basics of Software Project Management, Project Life Cycle, Role of Project Manager, Project Planning, Scope Management, Estimation Techniques: LOC, Function Point	CLO3	9
UNIT IV		
Project Planning & Scheduling: Work Breakdown Structure (WBS), Project Scheduling Techniques: Gantt Charts, PERT, CPM, Resource Allocation, Cost Estimation, Budgeting, Software Metrics	CLO4	9
UNIT V		
Risk Management & Project Monitoring: Risk Identification, Risk Analysis, Risk Mitigation Strategies, Project Monitoring, Project Control, Quality Assurance, Configuration Management, Agile Project Management Basics, Case Study on Software Project Failure/Success	CLO5	9
Total Hours		45 Hours

Learning resources

Textbooks:

1. Software Testing: Principles and Practices, Naresh Chauhan, Publication: Oxford University Press
2. Software Engineering, Ian Sommerville, Publication: Pearson Education
3. Software Project Management, Bob Hughes, Mike Cotterell, Rajib Mall, Publication: McGraw-Hill Education

Reference Books:

1. Foundations of Software Testing, Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, Publication: Cengage Learning
2. A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute (PMI), Publication: Project Management Institute
3. Agile Project Management with Scrum, Ken Schwaber, Publication: Microsoft PressOnline

Resources/E-Learning Resources

1. https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/SOFTWARE%20PROJECT%20MANAGEMENT.pdf
2. https://www.syedengg.ac.in/pdf/IT_StudyMaterial/VIII_Sem_MG6088_TM.pdf
3. https://ebooks.allfree-stuff.com/eBooks_down/Software%20Testing/Introduction%20to%20Software%20Testing.pdf
4. <https://www.guru99.com/software-testing.html>
5. Introduction to Software Testing - GeeksforGeeks





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COURSE CURRICULUM

Name of the Program:		MCA		Semester : I		Level: PG	
Course Name		Operating System		Course Code and Course Type		PM26MCCA104B	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-

Prerequisite: Basic Computer hardware and software knowledge

Course Objectives (CO):

The objectives of Optimization Techniques are:

1. To learn the fundamentals of Operating Systems and handle processes, threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To know the functionality of Multiprocessor OS and Mobile OS.
4. To gain knowledge on distributed operating system concepts.
5. To learn about the basics of Linux. 6. To learn programmatically to implement Linux OS mechanisms.

Course Learning Outcomes (CLO):

Students will be able to :

1. Understand the structure of OS, process management and synchronization. (Understand)
2. Understand multicore and multiprocessing OS. (Understand)
3. Explain Realtime and embedded OS (Understand)
4. Understand Windows and Linux OS fundamentals and administration. (Understand)
5. Solve shell scripting problems (Apply)

Course Contents and Syllabus:

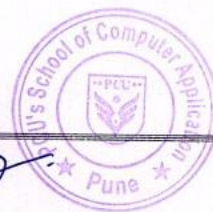
Descriptors and Topics	CLO	Hours
UNIT I		
Fundamentals of Operating Systems and Memory Management: Overview of operating systems, functionalities and characteristics of OS, hardware	CLO 1	9





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2026 Pattern (AS PER NEP 2020)

concepts related to OS, CPU states, I/O channels, memory management, memory management techniques, contiguous and non-contiguous allocation, logical and physical memory, conversion of logical to physical address, paging, demand paging, page replacement concept, segmentation, segment with paging, virtual memory concept, thrashing		
UNIT II		
Process Management, Synchronization, and File Systems: Process management and synchronization, PCB, job and processor scheduling, scheduling concept, process hierarchies, problems of concurrent processes, critical sections, mutual exclusion, synchronization, deadlock, device and file management, overview, techniques, file systems	CLO 2	9
UNIT III		
Multiprocessor, Multicore and Distributed Operating Systems: Multiprocessor and multicore operating systems, introduction, advantages and disadvantages, multicore system vs multiprocessor system, types of multiprocessors, symmetric multiprocessors, asymmetric multiprocessors, basic multicore concepts, memory sharing styles, uniform memory access (UMA), non-uniform memory access (NUMA), no remote memory access (NORMA), cache coherence, inter-process and intercore communication, shared memory, message passing, mobile operating systems, concept need and features, types of mobile OS, overview of Android OS, applications of mobile OS, distributed operating systems, concept need and features, examples of distributed OS with brief introduction, applications of distributed OS	CLO3	9
UNIT IV		
Real-Time and Embedded Operating Systems: Real-time OS, introduction and use of RTOS, components of RTOS, types of RTOS, features of RTOS, factors for selecting RTOS, applications of RTOS, disadvantages of RTOS, embedded OS, concept need and features of embedded OS, examples of embedded OS with brief introduction, applications of embedded OS	CLO4	9
UNIT V		
Windows and Linux Operating Systems: Windows OS and Windows Server architecture, Windows OS, introduction, Windows OS installation, process management, control panel overview, users security and privacy settings, accessibility settings, service management, syncing devices and file sharing, Windows utilities including accessories disk management resource monitor backup and recovery, basic troubleshooting including networking security device driver, introduction to Ubuntu, overview of kernel, installation of Ubuntu, file system, basic commands of Linux, managing processes in Linux, installing and deleting software packages, user management, file and device management, backup and recovery	CLO5	9
Total Hours		45





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Learning resources

Text Books:

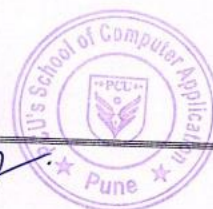
1. "Operating System Concepts", Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, Seventh Edition, John Wiley & Sons, 2004.
2. "Advanced Concepts in Operating Systems– Distributed, Database, and Multiprocessor Operating Systems", Mukesh Singhal and Niranjan G. Shivaratri, Tata McGraw-Hill, 2001.
3. "Understanding the Linux kernel", 3rd edition, Daniel P Bovet and Marco Cesati, O'Reilly, 2005. 4. "Real-Time Systems: Theory and Practice", Rajib Mall, Pearson Education India, 2006.
5. "iPhone iOS 4 Development Essentials – Xcode", Neil Smyth, Fourth Edition, Payload media, 2011.
7. "Microsoft Windows Server Administration Essentials", Tom Carpenter
8. "The Official Ubuntu Book" Eighth Edition, Matthew Helmke, Elizabeth K. Joseph, José Antonio, Rey Philip Ballew, With Benjamin Mako Hill

Reference Books:

1. "Operating Systems: Internals and Design Principles" by William Stallings.
2. "Operating Systems: A Concept-Based Approach" by D M Dhamdhare.
3. System Concepts, 9th Edition, John Wiley & Sons, Inc. by Avi Silberschatz, Peter Baer Galvin, Greg Gagne,
4. D.M Dhamdhare: Operating systems - A concept-based Approach, 3rd Edition, Tata McGraw- Hill, 2012.
5. Operating Systems: Internals and Design Principles, 8th edition Pearson Education Limited, 2014 by William Stallings.
6. Modern Operating system by Andrew Tanenbaum.
7. Distributed Operating System by Andrew Tanenbaum
8. P.C.P. Bhatt: Introduction to Operating Systems Concepts and Practice, 3rd Edition, PHI, 2010.
9. Harvey M Deital: Operating systems, 3rd Edition, Pearson Education, 2011

Online Resources and E.Learning Resources:

Windows Server certifications





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1. Entry level: IT Infrastructure: Microsoft Technology Associate (MTA) certification.
2. Associate level: Windows Server 2016: Microsoft Certified Solutions Associate (MCSA): Windows Server 2016 certification.
3. Associate level: Windows Server 2012: Microsoft Certified Solutions Associate (MCSA): Windows Server 2012 certification.
4. Expert level: Server infrastructure: Microsoft Certified Solutions Expert (MCSE): Server Infrastructure certification.



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COURSE CURRICULUM

Name of the Program:		MCA	Semester: I			Level: PG	
Course Name		Mathematical and Computational Thinking for Problem Solving	Course Code and Course Type			PM26MCCA105A	
Course Pattern		2026	Version			1.0	
Teaching Scheme			Assessment Scheme				
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	.	3	3	40	60	-

Prerequisite: Basic knowledge of mathematics, logical reasoning & fundamental computing concepts.

Course Objectives (CO):	The objectives of Optimization Techniques are: 1. Apply logical reasoning and mathematical proof techniques in computing. 2. Analyze discrete structures and their applications in computer science. 3. Design algorithms using computational thinking principles. 4. Perform basic data analysis and interpret results effectively. 5. Solve real-world problems using mathematical and computational models.
Course Learning Outcomes (CLO):	Students will be able to: 1. Apply logical and mathematical reasoning to solve computational problems. 2. Use discrete mathematical structures in computer science applications. 3. Design algorithms using computational thinking and analyses their efficiency. 4. Analyze data and build mathematical models for decision-making. 5. Solve real-world problems using integrated mathematical and computational approaches.





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Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I: Mathematical Logic and Reasoning		
Role of Mathematical Thinking in Computer Science, Propositional Logic: Statements, Connectives, Truth Tables, Logical Equivalence and Laws of Logic, Predicate Logic and Quantifiers, Methods of Proof: Direct, Contradiction, Contrapositive, Mathematical Induction (Simple and Strong), Problem-Solving Techniques (Polya's Framework), Applications of Logic in Programming and Algorithms	CLO 1	9
UNIT II: Discrete Mathematical Structures		
Set Theory: Operations, Identities, Power Sets, Relations: Properties, Equivalence Relations, Partial Orders, Functions: Types, Composition, Inverse Functions, Boolean Algebra: Laws, Simplification Techniques, Switching Circuits and Logic Gates, Normal Forms (CNF, DNF) and Applications, Introduction to Graph Theory: Terminology, Types of Graphs, Graph Representations and Applications in Computing	CLO 2	9
UNIT III: Computational Thinking and Algorithm Design		
Computational Thinking Concepts: Decomposition, Abstraction, Pattern Recognition, Algorithm Design Strategies, Flowcharts and Pseudocode, Recursion and Iteration Concepts, Efficiency of Algorithms: Basic Time and Space Complexity, Asymptotic Notations (Big-O, Big-Theta – Introductory), Problem Modeling and Stepwise Refinement, Case Studies of Algorithmic Problem Solving	CLO3	9
UNIT IV: Data Analysis and Mathematical Modelling		
Data Types and Data Representation, Descriptive Statistics: Mean, Median, Mode Measures of Dispersion: Variance and Standard Deviation, Basics of Probability: Rules and Applications, Correlation and Simple Regression (Introductory), Mathematical Modeling in Real-World Problems, Data Visualization (Charts, Graphs), Introduction to Tools (Excel / Python for basic analysis)	CLO4	9
UNIT V: Advanced Computational Applications		
Problem Solving using Graph Models, Optimization Concepts (Greedy Approach – Basic Idea) , Decision Making using Mathematical Models, Introduction to Machine Intelligence Concepts, Pattern Recognition and Data Interpretation, Logical Thinking in Programming (Debugging, Testing Logic), Case Studies (Industry-Oriented Problems), Mini Project / Problem-Based Assignment, Course Review and Integration	CLO5	9
Total Hours		45





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Learning resources:

Textbooks:

1. Kenneth H. Rosen – *Discrete Mathematics and Its Applications*
2. Susanna S. Epp – *Discrete Mathematics with Applications*
3. V. Rajaraman – *Computer Oriented Numerical Methods*
4. John V. Guttag – *Introduction to Computation and Programming Using Python*

Reference Books:

1. Thomas H. Cormen et al. – *Introduction to Algorithms*
2. Eric Lehman, F. Thomson Leighton – *Mathematics for Computer Science*
3. Seymour Lipschutz – *Discrete Mathematics (Schaum's Outline Series)*
4. Sheldon Ross – *Introduction to Probability Models*
5. Rajeev Motwani, Prabhakar Raghavan – *Randomized Algorithms*

Online Resources and E-Learning Resources:

1. NPTEL – Discrete Mathematics
https://onlinecourses.nptel.ac.in/noc24_cs98/preview
2. SWAYAM – Discrete Mathematics for Computer Science (IIT Kanpur)
https://onlinecourses.nptel.ac.in/noc25_cs27/preview
3. Mathematics for Computer Science
<https://ocw.mit.edu>
4. Computational Thinking for Problem Solving
<https://www.coursera.org/learn/computational-thinking-problem-solving>
5. Algorithm practice, computational thinking



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COURSE CURRICULUM:

Name of the Program:		MCA.		Semester: 1		Level: PG	
Course Name		Effective Written Communication		Course Code/ Course Type		PM26MCCA105B	
Course Pattern		202		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA(Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/Oral
3			3	3	40	60	-
Pre-Requisite: Basic knowledge of English							
Course Objectives (CO):				The objectives of Effective Written Communication are to: 1. To develop an understanding of the fundamental constituents and processes of business communication. 2. To enhance students' ability in sentence construction, paragraph development, and effective writing techniques. 3. To equip learners with professional writing skills, including business letters, reports, proposals, and formal documents. 4. To build awareness of nonverbal communication and its role in effective interpersonal and organizational communication. 5. To develop presentation skills and strategies for delivering clear, confident, and impactful oral and written presentations.			
Course Learning Outcomes (CLO):				Students would be able to: 1. Understand the constituents of business communication and the principles of effective sentence construction. 2. Develop professional writing skills using an appropriate format 3. Analyze and prepare structured business reports and technical proposals. 4. Interpret and apply nonverbal communication techniques. 5. Demonstrate effective presentation skills by using appropriate strategies.			

Course Contents/Syllabus:

Descriptors/Topics	CLO	Hours
UNIT I		
Constituents of Business Communication: Requisites of Sentence Construction, Paragraph Development: Techniques- Unity, Coherence and Emphasis, Methods- Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation-various steps.	CLO 1	6
UNIT II		



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Effective Writing Skills: Professional Writing; Purpose, Principles of effective writing, 3X3 writing process for business communication, Forms of written communication, Principles, Business Letters: Sales, Credit letters, Claim, Adjustment Letters, etc. Writing of CV and Resume, Memo, Drafting an e-mail, and Press Release. Agenda, Minutes, Notices	CLO 2	6
UNIT III		
Business Writing, Report Writing: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal: Definition; Types, Structure, Parts; Writing of Proposal; Significance.	CLO 3	6
UNIT IV		
Nonverbal Communication: Introduction To Kinesics: Eye Contact, Facial Expressions, Gestures and Postures, Proxemics: Personal, Social and Public Territories, Haptics, Chronemics, Locale Arrangement, Paralinguistics Communication: Pace, Pronunciation, Voice Intonation and Voice Modulation, Silence, and Pauses,	CLO 4	6
UNIT V		
Presentation: Strategies & Techniques Presentation: Definition, Purpose, Types: Individual and Group Presentation, Strategies for Oral and Written Presentation, Nuances of Delivery-Reading Method, Memorization, Impromptu and Speaking from the notes, Stage Fear, Audience and Locale Analysis	CLO 5	6

Learning resources

Textbooks:

1. Michelle Carey, Moira McFadden Lanyi, Deirdre Longo, Eric Radzinski, Shannon Rouiller, Elizabeth Wilde, Handbook of Technical Writing, Twelfth edition (June 15, 2020) by Bedford/St. Martin's
2. Allan Pease and Barbara, (2023), The Definitive Book of Body Language, Bantam Dell Pub Group, ISBN-13 978-0553383966
3. Business Communication for Success, University of Minnesota Libraries Publishing, ISBN 13: 9781946135056
4. Gupta N., Jain K., Business Communication, Sahitya Bhawan Publications, 2022

References:

1. J S Nesfield, English Grammar: Composition and Usage
2. Muralikrishna and S. Mishra, Communication Skills.

Additional Reading:

https://englishlessonsbrighton.co.uk/wp-content/uploads/2020/11/AWS_Print_Opening-Sample.pdf





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COURSE CURRICULUM: -

Name of the Program:		MCA		Semester : I		Level: PG	
Course Name		Research Methodology		Course Code and Course Type		PM26MCCA106	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-
Prerequisite: Basic understanding of Research concepts, Hypothesis formulation, and Problem Identification.							
Course Objectives (CO):				The objectives of Research Methodology are: 1. To develop an understanding of research concepts, processes, and design 2. To enable scholars to formulate research problems and hypotheses 3. To familiarize oneself with quantitative, qualitative, and mixed research methods 4. To build skills in data analysis, interpretation, and academic writing 5. To promote ethical research practices and publication quality			
Course Learning Outcomes (CLO):				Students will be able to: 1. Define and explain key concepts and methodologies of research and articulate research problems. 2. Analyse and summarize literature reviews, data types, and appropriate data collection techniques. 3. Design suitable sampling strategies and apply research designs for various problem scenarios. 4. Examine and apply hypothesis testing methods using appropriate statistical tools. 5. Develop a complete research report including all standard components using proper academic writing, citation styles, ethical research practices, and intellectual property rights.			

Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I		
Introduction to Research in Computing : Meaning, objectives, and significance of research in IT , Types of research: Fundamental, Applied, Experimental, Design-oriented , Research process in computer science projects, Identification of research	CLO 1	9





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2026 Pattern (AS PER NEP 2020)

problems in domains such as AI, Web, Data Science, and Cybersecurity. Literature review using digital libraries (IEEE, ACM, Google Scholar). Plagiarism awareness and academic integrity		
UNIT II		
Research Design and Problem Formulation: Research design: exploratory, experimental, simulation-based approaches, Problem statement formulation in computing research. Variables and hypothesis in IT research , Algorithm design vs research design ,Sampling in computing research (datasets, benchmarks, repositories) Feasibility analysis of research problems	CLO 2	9
UNIT III		
Data Collection and Pre-processing : Sources of data: datasets, APIs, repositories, user-generated data, Data collection methods: logs, sensors, surveys, web scraping basics , Tools and techniques for data acquisition , Data pre-processing: cleaning, transformation, normalization, Measurement metrics: accuracy, precision, recall, F1-score, Reliability and validation in experiments	CLO 3	9
UNIT IV		
Data Analysis and Experimental Evaluation: Descriptive statistics for computing data, Performance evaluation of algorithms and systems, Comparative analysis techniques, Basic hypothesis testing concepts, Data visualization (charts, graphs using Excel/Python basics) , Case study: evaluation of a machine learning model or software system	CLO 4	9
UNIT V		
Advanced Methods, Research Writing, and Ethics : Introduction to machine learning in research, Basics of data analytics and big data, Simulation and cloud-based experimentation, Reproducibility in computing research, Structure of project report / dissertation, Technical paper writing (IEEE format), Citation styles and referencing, Plagiarism detection tools and acceptable limits, Research ethics and publication process	CLO 5	9
Total Hours		45





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Learning resources

Textbooks:

C. R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, 4th Edition, 2018.

Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners" (for Reviewing the Literature under Module 2), SAGE Publications, 3rd Edition, 2011.

Study Material (For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013

Reference Books:

William M. K. Trochim, "Research Methods: The Concise Knowledge Base", Atomic Dog Publishing, 2005.

William G. Zikmund, "Business Research Methods", Cengage Learning.

Arlene Fink, "Conducting Research Literature Reviews: From the Internet to Paper", SAGE Publications, 2009.

Online Resources & E-Learning Resources:

1. <https://www.scribbr.com/research-process/>
2. <https://explorable.com/research-methodology>
3. <https://www.open.edu/openlearn/money-business/understanding-different-research-perspectives/content-section-8>
4. <https://www.ncrm.ac.uk/resources/online/>
5. <https://www.coursera.org/learn/research-methods>



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MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM

Name of the Program:		MCA		Semester: I		Level: PG	
Course Name		Introduction to Object-Oriented Programming (C++ / Java)		Course Code and Course Type		PM26MCCA107 / MOOC	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
2			2	2	50	-	-
Prerequisite:							
Course Objectives (CO):				The objectives of Effective Written Communication are to: 1. Understand the fundamentals and principles of Object-Oriented Programming (OOP). 2. Apply classes, objects, inheritance, polymorphism, encapsulation, and abstraction in software development. 3. Develop programs using exception handling, file handling, templates/generics, and STL concepts. 4. Analyse and implement design patterns, multithreading, and advanced OOP applications. 5. Design and develop real-world applications using object-oriented methodologies and best practices.			
Course Learning Outcomes (CLO):				Students will be able to : 1 Explain the concepts and principles of Object-Oriented Programming. 2 Develop programs using classes, objects, constructors, and inheritance concepts. 3 Implement polymorphism, abstraction, encapsulation, and exception handling techniques. 4 Analyse and utilise templates, generics, STL, and design patterns in application development. 5 Design and build real-world object-oriented applications using advanced programming concepts.			

Course Contents and Syllabus:



MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)

Descriptors and Topics	CLO	Hours
UNIT I		
Fundamentals of Object-Oriented Programming: Introduction to Programming Paradigms, History and Evolution of Object-Oriented Programming, Features of Object-Oriented Programming, Classes and Objects, Data Members and Member Functions, Constructors and Destructors, Access Specifiers, Encapsulation and Data Hiding, Abstraction Concepts, Simple Programs using Classes and Objects.	CLO 1	6
UNIT II		
Inheritance and Polymorphism: Inheritance Concept and Need, Types of Inheritance, Single Inheritance, Multiple Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Implementing Inheritance in C++ and Java, Method Overriding, Polymorphism, Static Polymorphism, Dynamic Polymorphism, Operator Overloading, Method Overloading, Virtual Functions, Runtime Polymorphism.	CLO 2	6
UNIT III		
Exception Handling, File Handling, Templates and Generics:- Introduction to Exception Handling, Types of Exceptions, Try-Catch Blocks, Throw and Throws Keywords, Custom Exceptions, File Handling Concepts, Reading and Writing Files, Text and Binary Files, Serialization and Deserialization, Template Functions, Template Classes in C++, Generics in Java and Python, Generic Classes and Methods.	CLO3	6
UNIT IV		
Standard Template Library and Design Patterns- Introduction to Standard Template Library (STL), Containers, Sequential Containers, Associative Containers, Iterators, STL Algorithms, Lambda Expressions Overview, Introduction to Design Patterns, Categories of Design Patterns, Singleton Design Pattern, Factory Design Pattern, Observer Design Pattern, Applications of Design Patterns in Software Development.	CLO4	6
UNIT V		
Advanced Object-Oriented Programming Concepts – Introduction to Design Patterns, Categories of Design Patterns, Singleton Design Pattern, Factory Design Pattern, Observer Design Pattern, Applications of Design Patterns in Software Development.	CLO5	6
Total Hours		30





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Text Books:

- 1 Object Oriented Programming with C++
Author, E. Balagurusamy
- 2 The Complete Reference Java
Author, Herbert Schildt
- 3 C++ Primer
Authors, Stanley B. Lippman, Josée Lajoie, Barbara E. Moo
- 4 Programming with Java
Author, E. Balagurusamy
- 5 Thinking in Java
Author, Bruce Eckel
- 6 The C++ Programming Language
Author, Bjarne Stroustrup

Reference Books:

- 1 Design Patterns: Elements of Reusable Object-Oriented Software
Authors, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides
- 2 Effective Java
Author, Joshua Bloch
- 3 The C++ Standard Library: A Tutorial and Reference
Author, Nicolai Josuttis

Online Reference Links

1. Official Java Documentation and Tutorials
[Oracle Java Tutorials](#)
2. Modern Java Learning Platform
[Learn Java by Oracle](#)
3. C++ Reference and STL Documentation
[Cplusplus Reference](#)
4. Modern C++ Documentation
[Cplusplus Reference](#)
5. Python Generics and Typing Documentation
[Python Typing Documentation](#)
6. Java Full Course Video Tutorial
[Oracle Java Full Course Video](#)
7. Object-Oriented Programming Concepts Reference
[GeeksforGeeks OOP Concepts](#)
8. Design Patterns Reference
[Refactoring Guru Design Patterns](#)





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2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM: -

Name of the Program:		MCA			Semester: 1		Level: PG	
Course Name		Basic Japanese Language skill			Course Code/Course		PM26MCCA108A	
Course Pattern		2024			Version		1.0	
Teaching Scheme					Assessment Scheme			
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral	
2	-	-	1	2	50	-	-	

Pre-Requisite: Desire to get acquainted with the Japanese language.

Course Objectives (CO):

- The objectives of Basic Japanese language skills are:
1. To meet the needs of the ever-growing industry, with respect to language support.
 2. To get introduced to Japanese society and culture through language.
 3. To acquire a competitive edge in career choices.
 4. To participate effectively & responsibly in a multicultural world.
 5. To enable learners to communicate effectively in the Japanese language.

Course Learning Outcomes (CLO):

- After learning the course, the students will be able to:
1. Read and write the Hiragana script.
 2. Write and speak basic sentences.
 3. Comprehend and speak about time, hobbies, likes and dislikes.
 4. Write basic kanji.
 5. Use the Hiragana script in discussion.

UNIT I

Introduction to Japanese Language

1. Introduction of Japanese culture & history
2. Speaking Self-introduction
3. Daily Greetings & Expressions
4. Numbers-1-20
5. Classroom Instructions

CLO 1

6

UNIT II

Introduction of Hiragana Script

1. Days of the week
2. Months, Days of the month
3. Colors, Age
4. Short video skit on self-introduction
5. Start with Hiragana script Series 1-3

CLO 2

6

UNIT III





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2026 Pattern (AS PER NEP 2020)**

Introduction of Hiragana Script 1.2 1. Hiragana script Series 4-6 2. Hiragana script Series 7-10 3. Writing Practice – Basic words 4. Hiragana Modified sounds 5. Hiragana Contracted sounds	CLO 3	6
UNIT IV		
Time and verbs 1. Speaking: Talking about routine 2. Reading: A clock 3. Writing: routine using verbs and time 4. Writing words using Hiragana Series, self-introduction in Hiragana script.	CLO 4	6
UNIT V		
Introduction of Katakana and basic kanji 1. Reading: English words, country names 2. Starting with Katakana series 3. Writing: Basic number Kanji 4. short video skit on self-introduction	CLO 5	6
Total		30

Learning Resources:

➤ **Textbooks:**

1. Minna no Nihongo, "Japanese for everyone", Elementary Main Textbook, Goyal Publishers & Distributors Pvt. Ltd.

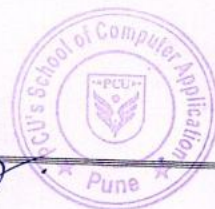
➤ **Reference books:**

1. Shyoho Volume I
2. Genki Japan
3. Ham vol. 1 & 2

➤ **Online Resources/E-Learning Resources:**

YouTube links:

- i. <https://youtu.be/1JephUxTHxg?si=ouCwTXZc tYgY9Kh>
- ii. <https://youtu.be/9EtbkBkF2ag?si=rLNzc55 REacMoGu>
- iii. <https://youtu.be/DpEolYasgv?si=dva9ue-YMSH03VOG>



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2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM: -

Name of the Program:	Foreign Language	Semester: I	Level: PG				
Course Name	Basic German Language skill	Course Code/ Course Type	PM26MCCA108B				
Course Pattern	2026	Version	1.0				
Teaching Scheme		Assessment Scheme					
Theory	Practical	Tutorial	Total Credits	Hours	CIA(Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
2	-	-	1	2	50	-	-
Pre-Requisite: Desire to get acquainted with the German Language.							
Course Objectives (CO):				The objectives of Basic German language skills are: 1. Identify and correctly pronounce the German alphabet, numbers, and basic expressions used in everyday communication. 2. Use common greetings, introductions, and simple conversational phrases in formal and informal contexts. 3. Construct basic sentences using personal pronouns and regular verb conjugations in the present tense. 4. Apply fundamental grammar concepts such as articles (definite/indefinite), singular-plural forms, and basic sentence structure. 5. Demonstrate the ability to ask and answer yes/no and WH-questions in simple conversations.			
Course Learning Outcomes (CLO):				After learning the course, the students will be able to: 1. Correct pronunciation of German alphabets, numbers, and basic greetings in simple interactions. 2. Introduce oneself and others using basic sentence structures and personal pronouns. 3. Describe hobbies, professions, days, months, and seasons using relevant vocabulary and simple sentences. 4. Form and respond to yes/no and WH-questions using correct articles and sentence structures. 5. Ask for and give directions, describe places, and use transport-related vocabulary effectively.			

Course Contents/Syllabus:

Topic / Description	CLO	Hours
Unit I		
Lektion 1: Guten Tag		
1. Alphabets, pronunciation keys 2. Numbers 0-20 3. Numbers 20-100 4. Greetings, Bidding bye 5. How are you doing? Formal and informal	1	6





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Unit II				
Lektion 1: Guten Tag				
1. Countries and languages				
2. Verb structure				
3. Personal pronouns		2	6	5
4. Verb Conjugation for regular verbs				
5. Basic sentence formation				
6. Self-introduction				
Unit III				
Lektion 2 Freunde, kollegen und ich				
1. Hobbies				
2. Weekdays, Months				
3. Season		3	6	5
4. Professions				
5. Regular and irregular verbs				
Unit IV				
Lektion 2 Freunde, kollegen und ich				
1. Definite Articles- der, die, das				
2. Singular and plural forms				
3. Yes/ no questions		4	6	5
4. Wh questions				
Unit V				
Lektion 3: In Hamburg				
1. To know and learn names of different buildings and places				
2. Learn to ask and guide the directions				
3. Mode of transport				
4. Imperativ form in 'Sie'				
5. Negative Articles- kein, keine		5	6	5
6. Indefinite Articles- ein, eine				
Total Hours			30	30

Learning Resources:

Textbook:

- 1) Netzwerk neu A1 – Published by Goyal Publishers and Distributors (updated text book)

Reference Books:

- 1) Brücke 1- Maharashtra state board Bureau of Textbook production
- 2) Hilfe Vol. 1 and 2 (Publisher – Nirali Publications)
- 3) Collins Grammar book (Publisher – Goyal Publisher and Distributors)
- 4) Grammatik Aktiv A1 – B1 (Publisher – Goyal Publisher and Distributors)

Online Resources:

- 1) You tube Channel
 - a. Easy German – <https://www.youtube.com/channel/Ucbxb2fqe9oNnglAoYqsYotQ>
 - b. Learn German with Anja – <https://www.youtube.com/channel/UCZwegPHTG4gvnR0Wlzaq5OQ>
 - c. German Speakers Club – <https://www.youtube.com/@germanspeakersclub29>
- 2) App
 - a. Duolingo
 - b. Deutsche Welle
 - c. Dict.cc



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2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM

Name of the Program:		MCA		Semester: I		Level: PG	
Course Name		Relational Database Management System Lab		Course Code and Course Type		PM26MCCA111	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
-	2	-	2	4	25	-	25
Prerequisite: Knowledge of DBMS							
Course Objectives (CO):				The objectives of the Relational Database Management System Lab are: To provide hands-on experience in designing and creating relational databases using SQL. To develop skills in data manipulation, querying, and database management operations. To implement database relationships, constraints, and normalization techniques. To perform advanced SQL operations, transactions, and database programming. To develop practical knowledge of database security, backup, and database connectivity.			
Course Learning Outcomes (CLO):				Students will be able to: Create and manage relational database schemas using SQL commands. Perform SQL queries, joins, functions, and nested queries for data retrieval and manipulation. Apply database concepts such as views, indexes, and database object management. Implement advanced database operations such as procedures, triggers, and transactions. Develop secure and database-driven applications using database connectivity and security mechanisms.			



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Course Contents and Syllabus: Practical Plan

Activity Number	Assignment / Practical / Activity Title	Week Number / Turn	Details	CLO	Hours
1	DBMS Installation	Week 1 / Practical 1	Install and configure MySQL/PostgreSQL	CLO1	2
2	Database Creation	Week 1 / Practical 2	Create databases using SQL commands	CLO1	2
3	Table Creation	Week 2 / Practical 1	Create tables using DDL commands	CLO1	2
4	Constraints	Week 2 / Practical 2	Apply primary key, foreign key, unique and not null constraints	CLO1	2
5	Insert Operations	Week 3 / Practical 1	Insert records into tables	CLO2	2
6	Update and Delete Operations	Week 3 / Practical 2	Perform UPDATE and DELETE operations	CLO2	2
7	Simple SELECT Queries	Week 4 / Practical 1	Execute SELECT queries with conditions	CLO2	2
8	Sorting and Filtering	Week 4 / Practical 2	Use ORDER BY, DISTINCT and WHERE clauses	CLO2	2
9	Aggregate Functions	Week 5 / Practical 1	Use COUNT, SUM, AVG, MIN and MAX functions	CLO2	2
10	Group By and Having	Week 5 / Practical 2	Implement GROUP BY and HAVING clauses	CLO2	2
11	Inner Join	Week 6 / Practical 1	Implement INNER JOIN queries	CLO2	2
12	Outer Joins	Week 6 / Practical 2	Implement LEFT and RIGHT JOIN queries	CLO2	2
13	Subqueries	Week 7 / Practical 1	Execute nested subqueries	CLO2	2
14	Correlated Subqueries	Week 7 / Practical 2	Execute correlated subqueries	CLO2	2
15	Nested Queries – Basic	Week 8 / Practical 1	Execute simple nested queries using SELECT statement	CLO3	2
16	Nested Queries with WHERE Clause	Week 8 / Practical 2	Implement nested queries using WHERE condition	CLO3	2
17	Nested Queries with Aggregate Functions	Week 9 / Practical 1	Use nested queries with MAX, MIN and AVG functions	CLO3	2



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18	Correlated Nested Queries	Week 9 / Practical 2	Execute simple correlated nested queries	CLO3	2
19	Views	Week 10 / Practical 1	Create and use SQL views	CLO3	2
20	Indexes	Week 10 / Practical 2	Create and manage indexes	CLO3	2
21	Stored Procedures	Week 11 / Practical 1	Create simple stored procedures	CLO4	2
22	Functions	Week 11 / Practical 2	Create and execute SQL functions	CLO4	2
23	Triggers	Week 12 / Practical 1	Implement database triggers	CLO4	2
24	Transactions	Week 12 / Practical 2	Perform COMMIT, ROLLBACK and SAVEPOINT operations	CLO4	2
25	User Creation	Week 13 / Practical 1	Create database users	CLO5	2
26	Permissions and Roles	Week 13 / Practical 2	Assign permissions and roles	CLO5	2
27	Backup Operations	Week 14 / Practical 1	Perform database backup operations	CLO5	2
28	Recovery Operations	Week 14 / Practical 2	Restore database from backup	CLO5	2
29	Mini Project – Database Design	Week 15 / Practical 1	Design database schema for mini project	CLO5	2
30	Mini Project Demonstration	Week 15 / Practical 2	Demonstrate complete database application	CLO5	2

Learning Resources

Textbooks:

1. Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan
2. Fundamentals of Database Systems – R. Elmasri and S. Navathe

Reference Books:

1. SQL, PL/SQL: The Programming Language of Oracle – Ivan Bayross
2. Database Management Systems – Raghu Ramakrishnan

Online Resources and E-Learning Resources:

1. <https://dev.mysql.com/doc/>
2. <https://www.postgresql.org/docs/>





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COURSE CURRICULUM

Name of the Program:	MCA	Semester: I	Level: PG				
Course Name	Data Structures and Algorithms Using C++ Lab	Course Code and Course Type	PM26MCCA112				
Course Pattern	2025	Version	1.0				
Teaching Scheme		Assessment Scheme					
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
-	2	-	2	4	25	-	25

Prerequisite: Students should learn at least one programming language, such as C++

Course Objectives (CO):	The objectives of the Data Structures and Algorithms Using C++ Lab are: 1. To Comprehend Perform basic operations on Arrays 2. To identify and apply different Searching and Sorting methods. 3. To apply the different algorithms for sorting and searching techniques. 4. To demonstrate and implement basic operations on a linked list, stack, and queue. 5. To develop and evaluate the Tree to solve problems.
Course Learning Outcomes (CLO):	Students will be able to: 1. Identify the concepts like array, matrix, traversing, and indexing using sorting and searching techniques. 2. Explain the appropriate data structures like Stack, queue as applied to the specified problem definition. 3. Apply the concepts of Linked Lists and it's applications on given data 4. Implement the knowledge of handle operations like searching, insertion, deletion, and traversing mechanisms on various data structures 5. Evaluate the non-linear data structures through Tree

Course Contents and Syllabus: Practical Plan:

Practical No.	Practical Title	Week No. and Turn	Details	CLO	Hours
1	Introduction to C++ for Data Structures	Week 1 /	classes, objects, pointers, dynamic memory allocation using new/delete	CLO1	2
2	Searching Algorithms	Week 2 /	implementation of linear search and binary search with complexity comparison	CLO2	2
3	Basic Sorting Algorithms	Week 3 /	bubble sort, selection sort, insertion sort	CLO2	2





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4	Advanced Sorting Algorithms	Week 4 /	quick sort and merge sort	CLO2	2
5	Heap and Radix Sort	Week 5 /	heap sort and radix sort implementation	CLO2	2
6	Singly Linked List	Week 11 /	insert, delete, search, traversal operations	CLO3	2
7	Advanced Linked List Operations	Week 12 /	reverse, count, sorted linked list operations	CLO3	2
8	Doubly and Circular Linked List	Week 13 /	insertion, deletion, traversal operations	CLO3	2
9	Stack using Array	Week 6 /	push, pop, display operations using array	CLO3	2
10	Stack using Linked List and Applications	Week 7 /	stack implementation using linked list, postfix evaluation	CLO3, CLO5	2
11	Queue using Array	Week 8 /	insert, delete, display operations	CLO3	2
12	Circular Queue and Deque	Week 9 /	circular queue and double-ended queue operations	CLO3	2
13	Priority Queue	Week 10 /	priority queue implementation and simple scheduling application	CLO3, CLO5	2
14	Tree and Binary Search Tree	Week 14 /	tree traversal (inorder, preorder, postorder), BST operations	CLO4	2
15	Graph Representation and Traversal	Week 15 /	adjacency matrix & list or simple real time application	CLO4, CLO5	2
				Total	30

Learning resources

Textbooks:

1. Robert Lafore, Object Oriented Programming in C++ 4e Paperback – 1, Pearson Education India; 4th edition (1 January 2008), ISBN13: 978-8131722824
2. E. Balagurusamy, Object Oriented Programming with C++, 8th Edition, McGraw Hill, 2020, ISBN13: 978-9389949186
3. C++ Primer Plus, Stephen Prata, 6th Edition, Pearson Education India, 2015.

Reference Books:

1. Bjarne Stroustrup, C++ Programming Language, Pearson Education; 4th edition (31 May 2022); ISBN13: 978-9356060135
2. Behrouz A. Forouzan, Richard F. Gilberg, C++ Programming: An Object-Oriented Approach, McGraw Hill, First Edition, 2022.
3. Herbert Schildt, The Complete Reference C++, McGraw Hill Education, 4th edition 2017.
4. Stanley Lippman, Josée Lajoie, Barbara Moo, C++ Primer, Addison-Wesley, 5th edition, 2012.

Online Resources and E-Learning Resources

1. <https://www.learncpp.com>
2. <https://cplusplus.com>
3. <https://www.programiz.com/cpp-programming>





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SEMISTER II





MCA CURRICULUM STRUCTURE 2026 Pattern (AS PER NEP 2020)

COURSE CURRICULUM

Name of the Program:		MCA		Semester : II		Level: PG	
Course Name		Advance Java Programming		Course Code and Course Type		PM26MCCA201	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-
Prerequisite: Core Java, OOP concepts, basic database knowledge, and web basics.							
Course Objectives (CO):				The objectives of this course are: 1. Apply advanced Java concepts to solve programming problems 2. Develop multithreaded and concurrent applications 3. Implement database connectivity using JDBC 4. Build web applications using Servlets and JSP 5. Develop REST APIs using Spring Boot			
Course Learning Outcomes (CLO):				Students would be able to: 1. Implement Java programs using collections and file handling 2. Develop and execute multithreaded applications 3. Perform CRUD operations using JDBC 4. Create dynamic web applications using Servlets and JSP 5. Build and deploy REST APIs using Spring Boot			

Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I: Advanced Java Fundamentals		
Java Collections Framework (List, Set, Map), Generics and Wrapper Classes, Lambda Expressions and Stream API (intro), File Handling (I/O streams, serialisation), Introduction to modular programming	CLO 1	9
UNIT II: Multithreading & Concurrency		



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Thread lifecycle and creation, Synchronisation and inter-thread communication, Executor framework and thread pools, Concurrency utilities (basic) Real-world use cases	CLO 2	9
UNIT III: JDBC & Database Connectivity		
JDBC architecture and drivers, CRUD operations, Prepared Statement & Callable Statement, Transaction management, Introduction to ORM (Hibernate basics)	CLO3	9
UNIT IV: Web Programming (Servlets & JSP)		
Servlet lifecycle and API, Request & response handling, Session management (cookies, sessions), JSP basics and directives, MVC architecture overview	CLO4	9
UNIT V: Spring Framework & Modern Development		
Introduction to Spring Framework, Spring architecture and modules, Dependency Injection (DI) and Inversion of Control (IoC), Introduction to Spring Boot, Creating REST APIs using Spring Boot, Spring MVC architecture, Connecting Spring Boot with database (JDBC/JPA basics) , Introduction to Microservices architecture	CLO5	9
Total Hours		45

Learning resources

Textbooks:

1. "Java: The Complete Reference", Herbert Schildt, McGraw Hill Education, ISBN-9781260440232.
2. "Spring in Action", Craig Walls, Manning Publications, ISBN-9781617294945.

Reference Books:

1. "Head First Servlets and JSP", Bryan Basham, Kathy Sierra, Bert Bates, O'Reilly Media, ISBN-9780596516680.
2. "Hibernate in Action", Gavin King, Manning Publications, ISBN-9781932394153.
3. "Effective Java", Joshua Bloch, Addison-Wesley, ISBN-9780134685991.

Online Resources and E.Learning Resources:

1. <https://nptel.ac.in>
2. <https://www.coursera.org>
3. <https://spring.io>
4. <https://docs.oracle.com>



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COURSE CURRICULUM

Name of the Program:		MCA		Semester: II		Level: PG	
Course Name		Advanced Web Technology		Course Code and Course Type		PM26MCCA202	
Course Pattern		2026		Version		1.0	
Teaching Scheme				Assessment Scheme			
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	40	60	-

Prerequisite: Basic understanding of web technologies, including HTML, CSS, and JavaScript .

Course Objectives (CO):

The objectives of Advanced Web Technology are:

1. To strengthen the fundamentals of modern web development technologies.
2. To develop server-side applications using Node.js and the npm ecosystem.
3. To build dynamic user interfaces using modern frontend libraries.
4. To design and develop full-stack web applications using database connectivity.
5. To deploy web applications using modern cloud platforms.

Course Learning Outcomes (CLO):

Students will be able to:

1. Apply modern web development practices and tools effectively.
2. Develop backend applications using Node.js and package management tools.
3. Design interactive frontend applications using component-based architecture.
4. Implement CRUD operations with database integration.
5. Build and deploy full-stack applications on cloud platforms.

Page 55



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2026 Pattern (AS PER NEP 2020)**

Course Contents and Syllabus:

Descriptors and Topics	CLO	Hours
UNIT I		
Modern Web Foundations & Tools: Overview of modern web architecture (client-server, REST), Revision of HTML5, CSS3, JavaScript (ES6 basics), Project structure and best practices, Introduction to Node.js, Introduction to npm, installing packages and managing dependencies, Version control using Git (basic commands), Debugging using browser developer tools	CLO 1	9
UNIT II		
Backend Development with Node.js: Node.js architecture and event-driven model, creating server using built-in modules, File system module (basic operations), Introduction to Express.js, Routing and middleware, REST API development (GET, POST, PUT, DELETE), JSON handling, Error handling basics	CLO 2	9
UNIT III		
Database & Backend Integration: Introduction to NoSQL databases, working with MongoDB, CRUD operations in MongoDB, Connecting Node.js with MongoDB, Introduction to Mongoose, Schema and model creation, Data validation, API + Database integration.	CLO3	9
UNIT IV		
Frontend Development with React: Introduction to React, Setting up project using npm, JSX and components, Props and state, Event handling, use State and use Effect (basic), Forms handling, React routing (basic)	CLO4	9
UNIT V		
Full Stack Integration & Deployment: Connecting React frontend with backend APIs, Implementing CRUD operations (end-to-end), Handling API calls (fetch/axios), Basic authentication concept (intro), Error handling and debugging, Deployment using GitHub (frontend), Backend deployment overview (e.g., Render concept), Project structuring and optimization.	CLO5	9
Total Hours		45



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Learning resources

Textbooks:

1. *Web Development with Node and Express* – Ethan Brown
2. *Learning React* – Alex Banks

Reference Books:

1. *MongoDB: The Definitive Guide* – Shannon Bradshaw
2. *Full Stack Web Development* – Fernando Monteiro

Online Resources and E-Learning Resources:

1. <https://react.dev/>
2. <https://nodejs.org/en/docs>



70/1



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COURSE CURRICULUM

Name of the Program:		MCA		Semester : II		Level: PG	
Course Name		An Introduction to Artificial Intelligence		Course Code and Course Type		PM26MCCA207 / MOOC	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
3	-	-	3	3	50	-	-
Prerequisite:							
Course Objectives (CO):				The objectives of Effective Written Communication are to: 1. Understand the fundamental concepts, philosophy, and problem-solving approaches of Artificial Intelligence. 2. Apply search techniques, heuristic methods, and optimisation algorithms for solving AI problems. 3. Analyse adversarial search, constraint satisfaction, and logical reasoning techniques used in intelligent systems. 4. Evaluate uncertainty handling methods, Bayesian networks, decision theory, and Markov Decision Processes. 5. Design intelligent systems using reinforcement learning, deep learning, and advanced AI techniques.			
Course Learning Outcomes (CLO):				Students will be able to : 1. Explain the concepts, philosophy, and applications of Artificial Intelligence. 2. Apply search algorithms, heuristic techniques, and optimization methods for problem solving. 3. Analyze adversarial search, logical reasoning, and constraint satisfaction problems. 4. Evaluate probabilistic reasoning models, Bayesian networks, and decision-making techniques. 5. Design intelligent systems using reinforcement learning, deep learning, and advanced AI models.			

Course Contents and Syllabus:





MCA CURRICULUM STRUCTURE
2026 Pattern (AS PER NEP 2020)

Descriptors and Topics	CLO	Hours
UNIT I		
Introduction to Artificial Intelligence and Search Techniques: Introduction to Artificial Intelligence, Philosophy and Definitions of AI, Intelligent Agents and Applications of AI, Problem Solving using AI, Modeling a Problem as a Search Problem, State Space Representation, Performance Measures, Uninformed Search Techniques, Breadth First Search, Depth First Search, Uniform Cost Search, Iterative Deepening Search, Search Strategy Comparison.	CLO 1	9
UNIT II		
Heuristic Search and Optimization Techniques: Heuristic Search Techniques, Best First Search, Greedy Search, A* Algorithm, Domain Relaxation, Local Search Algorithms, Hill Climbing, Simulated Annealing, Genetic Algorithms, Optimization Problems in AI, Applications of Heuristic and Evolutionary Techniques.	CLO 2	9
UNIT III		
Adversarial Search, Constraint Satisfaction and Logic:- Adversarial Search, Game Playing in AI, Minimax Algorithm, Alpha-Beta Pruning, Constraint Satisfaction Problems (CSP), Backtracking Search, Constraint Propagation, Propositional Logic, Logical Inference, Satisfiability Problems, Knowledge Representation, Reasoning in Intelligent Systems.	CLO3	9
UNIT IV		
Uncertainty and Probabilistic Reasoning- Introduction to Uncertainty in Artificial Intelligence, Probabilistic Reasoning, Bayesian Networks, Bayesian Inference, Learning Bayesian Networks, Decision Theory, Utility Theory, Probabilistic Decision Making, Markov Decision Processes (MDP), Sequential Decision Problems, Applications of Probabilistic Models.	CLO4	9
UNIT V		
Reinforcement Learning and Deep Learning- Introduction to Reinforcement Learning, Components of Reinforcement Learning Systems, Reward Mechanism, Q-Learning, Policy and Value Functions, Exploration vs Exploitation, Deep Learning Fundamentals, Neural Networks Overview, Deep Reinforcement Learning, Applications of Deep AI Systems, Case Studies in Modern Artificial Intelligence.	CLO5	9
Total Hours		45



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Recommended Text Books

1. Artificial Intelligence: A Modern Approach
Authors, Stuart Russell and Peter Norvig
2. Artificial Intelligence
Author, Elaine Rich
3. Deep Learning
Authors, Ian Goodfellow, Yoshua Bengio, Aaron Courville
4. Reinforcement Learning: An Introduction
Authors, Richard S. Sutton and Andrew G. Barto

Online Reference Links

1. [NPTEL Artificial Intelligence Course](#)
2. [Stanford Artificial Intelligence Resources](#)
3. [Deep Learning Specialization](#)
4. [OpenAI Research Resources](#)
5. [MIT OpenCourseWare Artificial Intelligence](#)
6. [TensorFlow Tutorials](#)
7. [PyTorch Learning Resources](#)



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COURSE CURRICULUM

Name of the Program:		MCA		Semester: II		Level: PG	
Course Name		Advance Java Programming Lab		Course Code/ Course Type		PM26MCCA211	
Course Pattern		2026		Version		1.0	
Teaching Scheme							
Assessment Scheme							
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/Oral
-	1	-	1	2	25	-	25
Pre-Requisite: Basic OOPs Concepts. Course Objectives (CO):				The objectives of this course are: 1 Apply advanced Java concepts to solve programming problems 2 Develop multithreaded and concurrent applications 3 Implement database connectivity using JDBC 4 Build web applications using Servlets and JSP 5 Develop REST APIs using Spring Boot			
Course Learning Outcomes (CLO):				Students would be able to: 1 Implement Java programs using collections and file handling 2 Develop and execute multithreaded applications 3 Perform CRUD operations using JDBC 4 Create dynamic web applications using Servlets and JSP 5 Build and deploy REST APIs using Spring Boot			

Course Contents/Syllabus: Practical Plan

Practical No	Practical Title	Week	CLO	Hours
1	Programs on Collections (Array List, HashSet, HashMap)	Week 1	CLO1	2
2	File Handling (Read/Write using File Reader & File Writer)	Week 2	CLO1	2
3	Serialisation and Deserialization of objects	Week3	CLO1	2
4	Multithreading using the Thread class	Week4	CLO2	2
5	Multithreading using the Runnable interface	Week 5	CLO2	2
6	Thread synchronisation example	Week 6	CLO2	2





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2026 Pattern (AS PER NEP 2020)**

7	JDBC Connection and simple SELECT query	Week 7	CLO3	2
8	JDBC CRUD operations (INSERT, UPDATE, DELETE)	Week 8	CLO3	2
9	Prepared Statement and transaction handling	Week 9	CLO3	2
10	Basic Servlet program (handling request/response)	Week 10	CLO4	2
11	Session management using cookies/session	Week 11	CLO4	2
12	JSP program with directives and form handling	Week 12	CLO4	2
13	Spring Boot project setup (basic application)	Week 13	CLO5	2
14	Create REST API using Spring Boot (GET/POST)	Week 14	CLO5	2
15	CRUD Web Application using Spring Boot + Database	Week 15	CLO5	2
Total				30 hrs.

Learning resources

Learning resources

Textbooks:

3. "Java: The Complete Reference", Herbert Schildt, McGraw Hill Education, ISBN-9781260440232.
4. "Spring in Action", Craig Walls, Manning Publications, ISBN-9781617294945.

Reference Books:

4. "Head First Servlets and JSP", Bryan Basham, Kathy Sierra, Bert Bates, O'Reilly Media, ISBN-9780596516680.
5. "Hibernate in Action", Gavin King, Manning Publications, ISBN-9781932394153.
6. "Effective Java", Joshua Bloch, Addison-Wesley, ISBN-9780134685991.

Online Resources and E.Learning Resources:

5. <https://nptel.ac.in>
6. <https://www.coursera.org>
7. <https://spring.io>
8. <https://docs.oracle.com>





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COURSE CURRICULUM

Name of the Program:		MCA		Semester: II		Level: PG	
Course Name		Advanced Web Technology Lab		Course Code and Course Type		PM26MCCA212	
Course Pattern		2026		Version		1.0	
Teaching Scheme					Assessment Scheme		
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical and Oral
-	1	-	1	2	25	-	25
Prerequisite: Basic understanding of web technologies, including HTML, CSS, and JavaScript							
Course Objectives (CO):				The objectives of Advanced Web Technology are: 1. To provide hands-on experience in setting up a web development environment using Node.js and npm. 2. To develop backend applications using server-side technologies and frameworks. 3. To implement database operations and integrate backend services with databases. 4. To design interactive frontend applications using modern JavaScript libraries. 5. To build and deploy full-stack web applications using industry-relevant tools and platforms.			
Course Learning Outcomes (CLO):				Students will be able to: 1. Install, configure, and use development tools and package managers effectively. 2. Develop server-side applications and REST APIs using backend technologies. 3. Perform CRUD operations and integrate applications with databases. 4. Design and implement interactive user interfaces using component-based architecture. 5. Develop, integrate, and deploy complete full-stack web applications.			



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Course Contents and Syllabus: Practical Plan

Activity Number	Assignment/Practical/ Activity Title	Week Number/Turn	Details	CLO	Hours
1	Node Setup	Week 1	Install Node.js & npm	CLO1	2
2	npm Practice	Week 2	Install and use packages	CLO1	2
3	Basic Server	Week 3	Create server using Node.js	CLO2	2
4	Express Setup	Week 4	Build server using Express	CLO2	2
5	Routing	Week 5	Implement routing in Express	CLO2	2
6	REST API	Week 6	Create CRUD API (no DB)	CLO2	2
7	MongoDB Setup	Week 7	Install and connect MongoDB	CLO3	2
8	CRUD MongoDB	Week 8	Perform DB operations	CLO3	2
9	Mongoose	Week 9	Schema & model creation	CLO3	2
10	API + DB	Week 10	Connect API with database	CLO3	2
11	React Setup	Week 11	Create React app	CLO4	2
12	Components	Week 12	Build React components	CLO4	2
13	Forms	Week 13	Form handling in React	CLO4	2
14	Full CRUD App	Week 14	React + Node + MongoDB	CLO5	2
15	Deployment	Week 15	Deploy app (GitHub)	CLO5	2

Learning resources

Textbooks:

1. Web Development with Node and Express – Ethan Brown
2. Learning React – Alex Banks

Reference Books:

1. MongoDB: The Definitive Guide – Shannon Bradshaw
2. Full Stack Web Development – Fernando Monteiro

Online Resources and E-Learning Resources:

1. <https://react.dev/>
2. <https://nodejs.org/en/docs>



7/11

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COURSE CURRICULUM

Name of the Program:		MCA		Semester: II		Level: PG	
Course Name		Japanese Language skill -L2		Course Code/Course			
Course Pattern		2024		Version		1.0	
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/Oral
2	-	-	1	2	25	-	25

Pre-Requisite: Desire to get acquainted with the Japanese language. Basic knowledge of Hiragana and Katakana.

Course Objectives (CO):

- The objectives of Basic Japanese language skill are:
1. To meet the needs of ever-growing industry, with respect to language support.
 2. To get introduced to Japanese society and culture through language.
 3. To promote multilingualism in exposing students to different cultures
 4. Fostering respect for linguistic diversity.
 5. Learning additional language to develop a better memory, talent for problem solving, ability to concentrate.

Course Learning Outcomes (CLO):

- Students would be able to:
1. Read & write words that have been borrowed from other language.
 2. Comprehend and speak basic conversation with basic particles
 3. Speak about Routine
 4. Basic sentence patterns incorporated into short dialogues indicating how they are used in actual conversation.
 5. Comprehend grammatical structure, and Improve communication abilities.

Descriptors/Topics	CLO	Hours
UNIT I		
Hiragana & Katakana Series		
i. Reading and writing basic words	CLO 1	6
ii. Read and Write Country		
iii. Speaking about daily routine, days, months.		
UNIT II		





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2026 Pattern (AS PER NEP 2020)**

Katakana Script			
i.	Katakana Script 3-6	CLO 2	6
ii.	Katakana Script 6-10		
iii.	Kanji Writing – Weekdays.		
UNIT III			
Basic Sentence formation			
i	Minna no Nihongo lesson no. 1	CLO 3	6
ii	Grammar - Basic sentence structure		
iii	Affirmative and Negative		
iv	General vocabulary: about family		
UNIT IV			
Basic Sentence formation			
i	Minna no Nihongo lesson no. 2- Vocabulary	CLO 4	6
ii	Grammar- Sentence formation using Demonstratives.		
iii	Demonstratives - Affirmative and Negative		
iv	Reading and speaking basic sentences.		
UNIT V			
Minna no Nihongo lesson no. 3			
i	Vocabulary lesson no 3	CLO 5	6
ii	Grammar- Sentence formation using Advanced Demonstratives.		
iii	Demonstratives - Affirmative and Negative		
Total Hours			30

Learning Resources:

Textbooks:

1. Minna no Nihongo, " Japanese for everyone", Elementary Main Textbook, Goyal Publishers & Distributors Pvt. Ltd.

Reference books:

4. Shyoho Volume I
5. Genki Japan
6. Ham vol. 1 & 2

➤ Online Resources/E-Learning Resources:

You Tube links:

1. <https://youtu.be/1JephUxTHxg?si=ouCwTXZc tYgY9Kh>
2. <https://youtu.be/9EtbkBkF2ag?si=rLNzc55 REacMoGu>
3. <https://youtu.be/DpEolYasvgv?si=dva9ue-YMSH03VOG>





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COURSE CURRICULUM

Name of the Program:		MCA		Semester: II		Level: PG	
Course Name		Basic German Language skill		Course Code/ Course Type			
Course Pattern		2026		Version		1.0	
Teaching Scheme							
						Assessment Scheme	
Theory	Practical	Tutorial	Total Credits	Hours	CIA (Continuous Internal Assessment)	ESA (End Semester Assessment)	Practical/ Oral
2	-	-	1	2	25	-	25
Pre-Requisite: Desire to get acquainted with the German Language							
Course Objectives (CO):				The objectives of this course are: 1. Apply German vocabulary related to food, markets, family, health, and daily routines in communication. 2. Construct sentences using the accusative case and appropriate verb structures in practical contexts. 3. Demonstrate the use of time expressions, prepositions, and possessive articles in describing daily activities. 4. Use modal verbs and imperative forms effectively to express requests, permissions, and instructions. 5. Communicate confidently in real-life situations such as shopping, dining, scheduling appointments, and healthcare interactions.			
Course Learning Outcomes (CLO):				Students would be able to: 1. Use food and market-related vocabulary to engage in basic conversations about meals, shopping, and currency. 2. Apply the accusative case and accusative verbs correctly in questions and statements. 3. Describe daily routines, family, and schedules using formal/informal time expressions, prepositions, and possessive articles. 4. Form and respond to questions using modal verbs and construct sentences expressing ability, necessity, and permission. 5. Communicate effectively in health-related situations using appropriate vocabulary, imperative forms, and conversational expressions.			





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Course Contents and Syllabus:

Topic / Description	CLO	Hours
Unit 01		
Lektion 4: Guten Appetit! 1. Food related vocabulary 2. To talk about food and beverages 3. Different types of Markets 4. Grocery and mealtimes 5. Currency of Germany	CLO 1	6
Unit 02		
Lektion 4: Guten Appetit! 1. Akkusative Case 2. Akkusative verbs 3. Wh questions and statements with akkusative verbs 4. Conversation related to food and drinks. 5. Conversation related to shopping	CLO 2	6
Unit 03		
Lektion 5: Tag für Tag 1. Formal Timings 2. Informal Timings 3. Family members 4. Prepositions- 'am', 'um', 'von...bis' 5. Possessive articles	CLO 3	6
Unit 04		
Lektion 5: Tag für Tag 1. Modal verbs concept 2. Modal verbs verb conjugation 3. Wh questions with modal verbs 4. Yes/no questions with modal verbs 5. Conversation- to book an appointment	CLO 4	6
Unit 05		
Lektion 8: Fit und Gesund 1. Vocabulary- Body parts, illness, medicines 2. Imperativ in du, Sie and ihr forms 3. Modal verbs 4. Conversation at hospital/ with doctor	CLO 5	6
Total Hours		30





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Learning Resources:

Textbook:

- 1) Netzwerk neu A1 – Published by Goyal Publishers and Distributors (updated text book)

Reference Books:

- 1) Brücke 1- Maharashtra state board Bureau of Textbook production
- 2) Hilfe Vol. 1 and 2 (Publisher – Nirali Publications)
- 3) Collins Grammar book (Publisher – Goyal Publisher and Distributors)
- 4) Grammatik Aktiv A1 – B1 (Publisher – Goyal Publisher and Distributors)

Online Resources:

- 1) You tube Channel
 - a. Easy German – <https://www.youtube.com/channel/UCbxb2fqe9oNgglAoYqsYOtQ>
 - b. Learn German with Anja – <https://www.youtube.com/channel/UCZwegPHTG4gynR0WLzaq5OQ>
 - c. German Speakers Club – <https://www.youtube.com/@germanspeakersclub29>
- 2) App
 - a. Duolingo
 - b. Deutsche Welle
 - c. Dict.cc
 - d. Linguee

