NEW HORIZON
COLLEGE OF ENGINEERING

# DEPARTMENT OF
# MASTER OF COMPUTER APPLICATIONS

## Academic Year 2024-25

# MCA

First & Second Semester Scheme & Syllabus
BATCH 2024-26
CREDITS:80

NEW HORIZON
COLLEGE OF ENGINEERING

Autonomous College Permanently affiliated with VTU, approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, accredited by NBA

# Department of Master of Computer Applications

## Academic Year 2024-25

# First and Second Semester MCA
# Scheme & Syllabus

## Batch: 2024-26

## Credits: 80

# CONTENTS

# NEW HORIZON COLLEGE OF ENGINEERING

## VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

## MISSION

To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.

To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

## QUALITY POLICY

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level.

## VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

# DEPARTMENT OF

## MASTER OF COMPUTER APPLICATIONS

## VISION

To emerge as a department of eminence in the field of Computer Applications in serving the Information Technology Industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

## MISSION

To strengthen the theoretical, practical and ethical aspects of the learning while inculcating a culture of research, innovation and practical applications amongst faculty and students.

To encourage long-term interactions between the department and the IT Industry through rich involvement of the Industry in the design of the curriculum and its hands-on implementation.

To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

## QUALITY POLICY

To provide services of the highest quality both curricular and co-curricular, so that our students can integrate their skills and serve the industry and society equally well at the global level.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

**PEO1** Excel in the field of Computer Applications and contribute to academia, industry and research.

**PEO2** Deliver software solutions that are socially relevant and adapt quickly to emerging technologies.

**PEO3** Demonstrate professional behavior by understanding ethical and communication skills to engage in lifelong learning.

# PROGRAMME OUTCOMES (POs)

**PO1** **(Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

**PO2** **(Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.

**PO3** **(Development of Solutions**): Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.

**PO4** **(Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

**PO5** **(Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.

**PO6** **(Project Management and Finance):** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

**PO7** **(Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.

**PO8** **(Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

# PROGRAM SPECIFIC OUTCOMES (PSOs)

## PSO1

To master skills in computing technologies to analyze, design and develop solutions for industry-oriented real-time computer applications.

## PSO2

To inculcate technical communication skills and ethics, with professional practices to strengthen research and enhance career opportunities.

## PEO to Mission Statement Mapping

| Mission Statements | PEO1 | PEO2 | PEO3 |
|---|---|---|---|
| To strengthen the theoretical, practical and ethical aspects of the learning while inculcating a culture of research, innovation and practical applications amongst faculty and students. | 3 | 3 | 3 |
| To encourage long-term interactions between the department and the IT Industry through rich involvement of the Industry in the design of the curriculum and its hands-on implementation. | 3 | 2 | 3 |
| To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co curricular and extracurricular activities. | 3 | 3 | 3 |

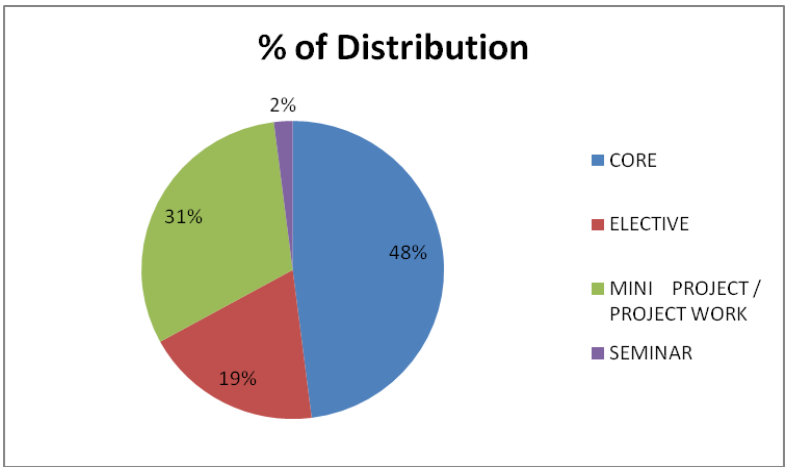
**Correlation:** 3- High, 2-Medium, 1-Low

## Mapping of POs to PEOs

| PO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| **PEO1** | **3** | **3** | **3** | **3** | **3** | **2** | **1** | **3** |
| **PEO2** | **3** | **3** | **3** | **2** | **3** | **2** | **1** | **3** |
| **PEO3** | **2** | **2** | **3** | **2** | **2** | **3** | **3** | **2** |

# DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
# MCA DEGREE CURRICULUM – COURSE CREDIT STRUCTURE
# BATCH 2024-26 : SEMESTER I TO IV

| SEMESTER | CORE | ELECTIVE | MINI PROJECT / PROJECT WORK | SEMINAR | TOTAL CREDITS |
|---|---|---|---|---|---|
| I | 20 | 0 | 0 | 0 | 20 |
| II | 12 | 6 | 2 | 0 | 20 |
| III | 6 | 3 | 11 | 0 | 20 |
| IV | 0 | 6 | 12 | 2 | 20 |
| **TOTAL** | 38 | 15 | 25 | 2 | 80 |
| **% of Distribution** | 48% | 19% | 31% | 2% | 100% |



# DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
# SCHEME OF FIRST SEMESTER MCA PROGRAM
# AY 2024-25

| S NO | BOARD/ COURSE | COURSE CODE | COURSE | BOS | CREDIT DISTRIBUTION | | | | OVERALL CREDITS | CONTACT HOURS WEEKLY (THEORY) | MARKS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | S | | | CIE | SEE | TOTAL |
| 1 | AS/BSC | 24MATC11 | COMPUTATIONAL MATHEMATICS | MCA | 2 | 1 | 0 | 0 | 3 | 4 | 50 | 50 | 100 |
| 2 | MCA/PCC | 24MCA12 | PROBLEM SOLVING WITH C | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 3 | MCA/PCC | 24MCA13 | OBJECT ORIENTED PROGRAMMING WITH JAVA | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 4 | MCA/PCC | 24MCA14 | COMPUTER NETWORKS | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 5 | MCA/IPCC | 24MCA15 | LINUX OPERATING SYSTEM AND SHELL SCRIPTING | MCA | 2 | 0 | 1 | 0 | 3 | 4 | 50 | 50 | 100 |
| 6 | MCA/IPCC | 24MCA16 | DATABASE MANAGEMENT SYSTEMS | MCA | 2 | 0 | 1 | 0 | 3 | 4 | 50 | 50 | 100 |
| 7 | MCA/PCCL | 24MCAL17 | PROGRAMMING WITH C LAB | MCA | 0 | 0 | 1 | 0 | 1 | 3 | 50 | 50 | 100 |
| 8 | MCA/PCCL | 24MCAL18 | OBJECT ORIENTED PROGRAMMING WITH JAVA LAB | MCA | 0 | 0 | 1 | 0 | 1 | 3 | 50 | 50 | 100 |
| 9 | AS/NCMC | 24MATC19 | FOUNDATION MATHEMATICS FOR COMPUTER APPLICATIONS * | MCA | - | - | - | - | - | 3 | 50 | - | 50 |
| TOTAL | | | | | 15 | 1 | 4 | 0 | 20 | 27 | 400 | 400 | 800 |

Note: **BSC** – Basic Science Courses, **PCC** - Professional Core Courses,
**IPCC** - Integrated Professional Core Courses, (No SEE for lab component, only CIE), **PCCL** - Professional Core Course Lab
**L** – Lecture, **T**- Tutorial, **P**-Practical, **S** - Self Study

Research Methodology and IPR Online Course should be mandatorily taken by the students anytime during the program, However the marks will be included in 4th semester. Students have to qualify it for the award of master's degree

*Bridge Course : Non-Credit Mandatory Course 24MATC19- Foundation Mathematics for Computer Applications : Students who have not taken Mathematics at the 10+2 or degree level are required to study and pass this course in the 1st semester. However, this course/ subject will not be considered for vertical progression.

# DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
# SCHEME OF SECOND SEMESTER MCA PROGRAM
# AY 2024-25

| S NO | BOARD/ COURSE | COURSE CODE | COURSE | BOS | CREDIT DISTRIBUTION | | | | OVERALL CREDITS | CONTACT HOURS WEEKLY (THEORY) | MARKS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | S | | | CIE | SEE | TOTAL |
| 1 | MCA/PCC | 24MCA21 | DATA STRUCTURES | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 2 | MCA/PCC | 24MCA22 | ADVANCED JAVA | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 3 | MCA/PCC | 24MCA23 | DESIGN AND ANALYSIS OF ALGORITHMS | MCA | 3 | 0 | 0 | 0 | 3 | 4 | 50 | 50 | 100 |
| 4 | MCA/PEC | 24MCA24X | PROFESSIONAL ELECTIVES-1 | MCA | 3 | 0 | 0 | 0 | 3 | 3 | 50 | 50 | 100 |
| 5 | MCA/PEC | 24MCA25X | LAB BASED PROFESSIONAL ELECTIVES-1 | MCA | 0 | 1 | 2 | 0 | 3 | 6 | 50 | 50 | 100 |
| 6 | MCA/PCCL | 24MCAL26 | DATA STRUCTURES AND ALGORITHMS LAB | MCA | 0 | 0 | 1.5 | 0 | 1.5 | 3 | 50 | 50 | 100 |
| 7 | MCA/PCCL | 24MCAL27 | ADVANCED JAVA LAB | MCA | 0 | 0 | 1.5 | 0 | 1.5 | 3 | 50 | 50 | 100 |
| 8 | MCA/AEC | 24MCA28 | MINI PROJECT | MCA | 0 | 0 | 0 | 2 | 2 | - | 50 | 50 | 100 |
| TOTAL | | | | | 12 | 1 | 5 | 2 | 20 | 25 | 400 | 400 | 800 |

Note: **PCC** - Professional Core Courses, **PEC** – Professional Elective Course, **PCCL** - Professional Core Course Lab,
**AEC-** Ability Enhancement Course
**L** – Lecture, **T**- Tutorial, **P**-Practical, **S** - Self Study

*Research Methodology and IPR Online Course should be mandatorily taken by the students anytime during the program, However the marks will be included in 4th semester. Students have to qualify it for the award of master's degree.
AEC- Students are required to select topics such as ERP, R Programming, Scripting Languages, Web Development Applications, etc. Students must develop a small prototype based on their chosen topic and demonstrate it.
A one-week intensive communication skills training program will be scheduled during the vacation.

| | PROFESSIONAL ELECTIVES-1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SNO | COURSE CODE | COURSE | BOS | | CREDIT DISTRIBUTION | | | TOTAL |
| | | | | L | T | P | S | |
| 1 | 24MCA241 | CLOUD COMPUTING | MCA | 3 | 0 | 0 | 0 | 3 |
| 2 | 24MCA242 | CYBER SECURITY AND CYBER LAW | MCA | 3 | 0 | 0 | 0 | 3 |
| 3 | 24MCA243 | CRYPTOGRAPHY AND NETWORK SECURITY | MCA | 3 | 0 | 0 | 0 | 3 |
| 4 | 24MCA244 | ARTIFICIAL INTELLIGENCE | MCA | 3 | 0 | 0 | 0 | 3 |
| 5 | 24MCA245 | SOFTWARE ENGINEERING AND TESTING | MCA | 3 | 0 | 0 | 0 | 3 |

| | LAB BASED PROFESSIONAL ELECTIVES-1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SNO | COURSE CODE | COURSE | BOS | | CREDIT DISTRIBUTION | | | TOTAL |
| | | | | L | T | P | S | |
| 1 | 24MCA251 | BUSINESS INTELLIGENCE AND DATA ANALYTICS | MCA | 0 | 1 | 2 | 0 | 3 |
| 2 | 24MCA252 | MOBILE APPLICATION DEVELOPMENT | MCA | 0 | 1 | 2 | 0 | 3 |
| 3 | 24MCA253 | COMPETITIVE PROGRAMMING WITH PYTHON | MCA | 0 | 1 | 2 | 0 | 3 |
| 4 | 24MCA254 | NON RELATIONAL DATABASES (NoSQL) WITH MongoDB | MCA | 0 | 1 | 2 | 0 | 3 |
| 5 | 24MCA255 | ASP.NET WITH C# | MCA | 0 | 1 | 2 | 0 | 3 |

# FIRST SEMESTER

# MCA SYLLABUS

# (2024-25)

# COMPUTATIONAL MATHEMATICS

| | | | |
|---|---|---|---|
| **Course Code** | **24MATC11** | **CIE Marks** | **50** |
| **L:T:P:S** | **2:1:0:0** | **SEE Marks** | **50** |
| **Hrs. / Week** | **4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MATC11.1 | Understand the fundamental concepts of Differentiation, Integration and Matrices and its importance. |
| 24MATC11.2 | Analyze the ordinary Differential Equations and its solution associated with different mathematical models. |
| 24MATC11.3 | Apply the numerical methods to obtain approximate solution of mathematical problems. |
| 24MATC11.4 | Understand the fundamental concepts of sets, relations and functions. |
| 24MATC11.5 | Analyze mathematical concepts like statistics and probability theory to optimize the solutions of complex problem. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MATC11.1 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC11.2 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC11.3 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC11.4 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC11.5 | 3 | 3 | - | - | - | - | - | - | 2 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **MATHEMATICAL FOUNDATIONS** | **24MATC11.1** | **8 Hours** |

Differentiation- Product Rule, Quotient Rule, Chain Rule and Applications of Finding Velocity and Acceleration. Integration- Definite & Indefinite Integration and Integration by Parts. Matrices- Determinant and Inverse of A Matrix, Eigen Values and Eigen Vectors of a Square Matrix.

| | |
|---|---|
| Text Book | Text Book 3: Chapter 4.1, 4.2, 6.1, 6.2, 6.3, 6.4 2.13, 2.14 Text Book 4: Chapter 1 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **ORDINARY DIFFERENTIAL EQUATIONS** | **24MATC11.2** | **8 Hours** |

First-Order Differential Equations- Variable Separable Method, Exact and Linear Differential Equations. Second and Higher Order Differential Equations with Constant Coefficients: Finding Complementary Function and Particular Integral of the Types $e^{ax+b}$, Sin (ax+b) and Cos (ax+b).

| | |
|---|---|
| Text Book | Text Book 3: Chapter 11.5, 11.6, 11.9, 13.2, 13.3, 13.4, 13.5 |
| Case Study | Case study on applications of first order differential equations to electric circuits. |

| | | | |
|---|---|---|---|
| **MODULE-3** | **NUMERICAL ALGORITHMS** | **24MATC11.3** | **8 Hours** |

Roots of Algebraic and Non-Algebraic Equations- Newton Raphson Iteration Method.
Numerical Integration- Trapezoidal Rule, Simpson's One-Third Rule. Solution of System of Linear Equations- Gauss Seidel Iteration Method.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 28.1, 28.2, 28.3, 28.7, 30.5, 30.6, 30.7 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **SETS, RELATIONS AND FUNCTIONS** | **24MATC11.4** | **8 Hours** |

Basics of Set Theory, Cartesian Product of Sets. Relations, Properties of Relations, Equivalence Relations and Partitions, Pigeonhole Principle.
Functions- One to One and Onto Functions, Function Composition and Inverse Function.

| | |
|---|---|
| Case Study | Case study on Posets and Hasse diagrams. |
| Text Book | Text Book 2: Chapter 5.1, 5.2, 5.3, 5.5, 5.6, 7.1, 7.4 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **PROBABILITY DISTRIBUTIONS** | **24MATC11.5** | **8 Hours** |

Random Variables Discrete and Continuous, Probability Density Function and Cumulative Density Function. Discrete Probability Distribution, Binomial Distribution, Poisson Distribution. Continuous Probability Distribution Exponential Distribution and Normal Distribution.

| | |
|---|---|
| Case Study | Case Studies on Joint Probability Distributions. |
| Text Book | Text Book 3: Chapter 26.1, 26.2, 26.3, 26.4, 26.5 |

**CIE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 5 | - |
| L2 | Understand | 5 | 5 | - |
| L3 | Apply | 10 | 5 | 10 |
| L4 | Analyze | 2.5 | - | - |
| L5 | Evaluate | 2.5 | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 5 |
| L5 | Evaluate | 5 |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Xin-She Yang, Introduction to Computational Mathematics, World Scientific Publishing Co. Pte. Ltd., Second Edition, 2015, ISBN: 9789814635776.
2) Ralph P Grimaldi, B.V.Ramana, Discrete and Combinatorial Mathematics, An applied Introduction, 5th Edition, Pearson Education, 2007, ISBN-10: 8177584243, ISBN-13: 9788177584240.
3) B.S.Grewal, Numerical Methods in Engineering and Science, Khanna Publishers, 11th Edition, 2013, ISBN: 9788174092489.
4) G.I.; V.P. Dymnikov Marchuk**,** Problems of Computational Mathematics and Mathematical Modelling, MIR Publishers, First Edition, 1985, ISBN: 978-0828533744.


**Reference Books:**


1) David C. Lay, Steven R. Lay and Judi J. McDonald, Linear Algebra and its Applications, Pearson Education Limited, Fifth Edition, 2016, ISBN: 978-0321982384.
2) Kenneth H Rosen, Discrete Mathematics & its applications, 7th Edition, McGraw-Hill, 2010, ISBN-10: 0073383090, ISBN-13: 978-0073383095.
3) M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International (P) Limited, Fifth Edition, 2007, ISBN: 8122420012.
4) S. M. Ross, Stochastic Processes, Wiley Publishers, Second Edition, 1995, ISBN: 978-0471120629.

**Web links and Video Lectures (e-Resources):**

- https://youtu.be/5yfh5cf4-0w
- https://youtu.be/U9H7RJvSGuQ
- https://youtu.be/6WUjbJEeJwM
- https://youtu.be/Jt5R-Tm8cV8
- https://byjus.com/maths/differential-calculus/
- https://youtu.be/r1NcVEE3ySI
- https://youtu.be/aTZeAZzd0WQ
- https://youtu.be/r1euNQ03QjE
- https://youtu.be/O3ahEHAX-KU
- https://youtu.be/HKvP2ESjJbA
- https://youtu.be/zadUB3NwFtQ
- https://youtu.be/LHsPJ2bQX1U
- https://youtu.be/xrGVe6gMRyk
- https://youtu.be/9YKLXFqCy6E
- https://youtu.be/Hg38kfK5w4E

**Activity-Based Learning (Suggested Activities in Class)/Practical Based Learning:**

- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/ Flowcharts/ Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

****

## PROBLEM SOLVING WITH C

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA12** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA12.1 | Discuss the fundamentals of number systems and programming in C. |
| 24MCA12.2 | Use C programming constructs to solve simple problems. |
| 24MCA12.3 | Apply the logic of arrays and strings for solving different problems. |
| 24MCA12.4 | Analyze a given problem and identify the functions needed to solve it. |
| 24MCA12.5 | Design and develop comprehensive C program to solve real world applications. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA12.1 | 3 | - | - | - | - | - | - | - | 2 | - |
| 24MCA12.2 | 3 | - | - | - | - | - | - | - | 2 | - |
| 24MCA12.3 | 3 | 1 | 1 | - | - | - | - | - | 2 | - |
| 24MCA12.4 | 3 | 1 | 1 | - | - | - | - | - | 2 | - |
| 24MCA12.5 | 3 | 1 | 1 | - | - | - | - | - | 2 | - |

| **MODULE-1** | **INTRODUCTION TO NUMBER SYSTEM AND C PROGRAMMING** | **24MCA12.1** | **8 Hours** |
|---|---|---|---|

Number Systems, Binary, Octal and Hexadecimal Numbers, Number Base Conversion, Binary code, Binary Storage and Registers, Problem-Solving Aspect, Algorithms, Pseudo code and Flowchart.
Constants, Variables and Data Types, Operators and Expressions, Managing Input/ Output Operations, Formatted Input and Output using format Specifiers.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 2, 3, 4, Text Book 2: Chapter 1, Text Book 3: Chapter 1 |

| **MODULE-2** | **CONTROL STRUCTURES IN C** | **24MCA12.2** | **8 Hours** |
|---|---|---|---|

Control Statements- Decision making and Branching: if Statement, Simple if Statement, if-else Statement, Nesting of if-else Statements, else-if Ladder, switch Statement. Decision making and Looping- while, do-while, for Loop, Nested Loops, and Jumping Statements- goto, break, continue, exit, return.

| | |
|---|---|
| Self-study / Case Study / Applications | Identify the usage of the type of Control Statements used in Solving Different Problems. |
| Text Book | Text Book 1: Chapter 5, 6 |

| **MODULE-3** | **ARRAYS AND STRINGS** | **24MCA12.3** | **8 Hours** |
|---|---|---|---|

Array Techniques- One-Dimensional, Two-Dimensional and Multi-Dimensional Arrays, Declaration and Initialization of Arrays, Reading, Writing and Manipulation of Arrays, Array Operations.
Strings- Declaring and Initializing String Variables, Reading String from Terminal, Writing String to Screen, Arithmetic Operations on Characters, String Handling Functions, Other Features of Strings, Programming Examples.

| | |
|---|---|
| Self-study / Case Study / Applications | Self-Study on the Usage of Arrays in Real Time Applications. |
| Text Book | Text Book 1: Chapter 7, 8 |

| **MODULE-4** | **FUNCTIONS AND COMPLEX DATA TYPES** | **24MCA12.4** | **8 Hours** |
|---|---|---|---|

Functions- Need for User Defined Functions, a Multi- Function Program, Elements of User Defined Functions, Defining Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions, Recursion, Passing Arrays to Functions, Passing String to Functions, Call-by-Value and Call-by Reference.
Structures and Unions- Defining a Structure, Declaring Structure Variables, Accessing Structure Members, Structure Initialization, Copying and Comparing Structure Variables, Operations on Individual Members, Array of Structures, Structures within Structures, Unions, Size of Structures and Unions, and User-Defined Data

| | | | |
|---|---|---|---|
| Types- enum, typedef, Bit Fields. | | | |
| Text Book | Text Book 1: Chapter 9, 10 | | |
| **MODULE-5** | **POINTERS AND FILES** | **24MCA12.5** | **8 Hours** |

Pointers- Understanding Pointers, Accessing the Address Space of a Variable, Declaring and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Chain of Pointers, Pointer Arithmetic, Pointers and Arrays, Pointer and Character Strings, Pointer as Function Arguments, Functions Returning Pointers, Dynamic Memory Allocation.

Introduction to FILE Handling Techniques- File Management in C, Defining and Opening a file, Closing a file, input/output Operations on Files, Command Line Arguments.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 11, 12, 13 |

**CIE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 10 | 5 | 5 |
| L2 | Understand | 10 | 5 | 5 |
| L3 | Apply | 5 | 5 | - |
| L4 | Analyze | - | - | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 20 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | - |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) E. Balaguruswamy, "Programming in ANSI C", McGrawHill Publishers, 9th Edition, 2024, ISBN: 13-978-9355326720.
2) Joyce Farrell, Programming Logic & Design, CENGAGE learning, 9th Edition, 2018, ISBN: 13-978-1337109635.
3) Digital Logic and Computer Design, "M. Morris Mano", Pearson Education India, 2016, ISBN: 13-978-9332542525.


**Reference Books:**


1) V Rajaraman: Computer Programming in C, PHI, 2019, ISBN: 9789388028332.
2) Peter Norton, "Introduction to Computers", 7th Edition, McGraw Hill Education, 2017, ISBN: 9789387067028.


**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc22_cs40/preview
- https://onlinecourses.nptel.ac.in/noc23_cs53/preview
- https://www.coursera.org/specializations/c-programming

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:**

- Group Discussions
- Practical Exercises

****

## OBJECT ORIENTED PROGRAMMING WITH JAVA

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA13** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA13.1 | Discuss the fundamentals of object-oriented programming and Java Execution Environment. |
| 24MCA13.2 | Summarize the usage and application of String handling and Object Oriented Techniques. |
| 24MCA13.3 | Illustrate the principles of Inheritance packages and Interface implementation. |
| 24MCA13.4 | Analyze Exception Handling mechanisms and Multi Threading in Java. |
| 24MCA13.5 | Examine Java Generics Collection Interfaces and AWT components for File Handling and GUI development. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA13.1 | 3 | 3 | 2 | - | 3 | - | 1 | - | 3 | - |
| 24MCA13.2 | 3 | 3 | 3 | - | 2 | - | 2 | - | 3 | - |
| 24MCA13.3 | 3 | 2 | 2 | - | 3 | - | 1 | - | 3 | - |
| 24MCA13.4 | 3 | 3 | 3 | - | 2 | - | 2 | - | 3 | - |
| 24MCA13.5 | 3 | 2 | 1 | 2 | 3 | - | - | - | 3 | - |

| **MODULE-1** | **OVERVIEW OF JAVA** | **24MCA13.1** | **8 Hours** |
|---|---|---|---|

Introduction, Object-Oriented Programming Concepts, JDK, JRE, JVM, Program Structure. Data Types, Variables, Scope Of Variables, Operators, Expression, Keywords, Identifiers, Class Libraries, Primitive Types, Wrapper Classes, Literals, Type Conversion, Input and Output Statements, Decision Making, Branching, Loop Control Statements, Enumeration, Class Fundamentals, Objects, Methods, Constructors, This Keyword, Garbage Collection, Finalize( ) Method.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1, 2, 3, 4, 5, 6, 19, Text Book 2: Chapter 22 |

| **MODULE-2** | **ARRAYS AND STRING HANDLING** | **24MCA13.2** | **8 Hours** |
|---|---|---|---|

Arrays- Fundamentals, Types, Passing Array to a Method, Array of Objects.
String Constructors, Methods, String Buffer, String Builder, String Tokenizer, Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Static, Final, Nested Classes, VarArgs.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 7, 18 |

| **MODULE-3** | **INHERITANCE** | **24MCA13.3** | **8 Hours** |
|---|---|---|---|

Basics, Types, Super, Visibility Control, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces – Extending Multiple Interfaces, Implementing Interfaces, Nested Interfaces, Marker Interfaces, Packages -Fundamentals, Types, Accessing Packages, Importing Packages.

| | |
|---|---|
| Self-study / Case Study / Applications | Create an Interactive Application which demonstrates the different types of Inheritance. |
| Text Book | Text Book 1: Chapter 8, 9 |

| **MODULE-4** | **EXCEPTION HANDLING AND MULTITHREADING** | **24MCA13.4** | **8 Hours** |
|---|---|---|---|

Fundamentals, Exception Types, Try-Catch-Finally, Multiple Catch Clauses, Nested Try Statements, Throw, Throws, Built-In Exceptions, Custom Exceptions. Multithreaded Programming – Fundamentals, The Java Thread Model, Lifecycle, Thread Priorities, Thread Creation using Extends, using Implements Keyword, Creating Multiple Threads, Thread Methods, Synchronization - Synchronization Methods, Synchronized Statement, Thread Communication - notify(), wait() and notifyAll().

| | |
|---|---|
| Self-study / Case Study / Applications | • Create an interactive Multithreading application using various methods of Thread class.<br>• Develop an interactive application which uses User-Defined Exceptions. |
| Text Book | Text Book 1: Chapter 10, 11 |

| MODULE-5 | GENERICS, COLLECTIONS, AWT AND I/O OPERATIONS | 24MCA13.5 | 8 Hours |
|---|---|---|---|

Generics – Advantages, Generic Methods, Generic Constructors, Generic Classes. Collection Interfaces. Java AWT - Components, Layouts, Event Handling, Listeners, IO Stream Classes, File Handling.

| Text Book | Text Book 1: Chapter 13, 14, 20, 22 Text Book 2: Chapter 23, 24, 27, 29 |
|---|---|

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 3 | 2 |
| L2 | Understand | 5 | 4 | 2 |
| L3 | Apply | 10 | 4 | 3 |
| L4 | Analyze | 5 | 4 | 3 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Herbert Schildt, Java The Complete Reference, 13th Edition, Tata McGraw Hill, January 2024, ISBN: 13-978-1265058432.
2) R. Nageswara Rao, Core Java: An Integrated Approach, New: Includes All Versions upto Java 8, Publisher Dreamtech Press, January 2016, ISBN: 13-978-9351199250.


**Reference Books:**


1) Core Java Volume I – Fundamentals, Cay S. Horstmann, Prentice Hall, 11th Edition May 2018, ISBN: 13-978-0135166307.
2) Head first Java 3rd Edition, 2022, O'Reilly publications, ISBN: 13-978-9355420909.


**Web links and Video Lectures (e-Resources):**

- https://www.javatpoint.com/inheritance-in-java
- https://archive.nptel.ac.in/courses/106/105/106105191/
- https://java-iitd.vlabs.ac.in/
- https://www.tutorialspoint.com/java/java_multithreading.htm
- https://www.w3schools.com/java/java_try_catch.asp
- https://www.programiz.com/java-programming/collections

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:**

- Video demonstration of latest technologies in Java.
- Case study on real world problems
- Expert talk &Seminars

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## COMPUTER NETWORKS

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA14** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA14.1 | Discuss the basic concepts of networks and reference models. |
| 24MCA14.2 | Use protocols and algorithms to setup and troubleshooting networks. |
| 24MCA14.3 | Analyze network traffic to identify bottlenecks or security vulnerabilities. |
| 24MCA14.4 | Summarize the functions and mechanisms of transport layer protocol. |
| 24MCA14.5 | Interpret the data exchanged in application layer protocol to understand their behavior and performance. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA14.1 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| 24MCA14.2 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| 24MCA14.3 | 2 | - | 1 | - | - | - | - | - | 3 | 2 |
| 24MCA14.4 | 1 | - | - | 1 | - | - | - | - | 3 | 2 |
| 24MCA14.5 | 1 | 3 | 1 | 1 | - | - | - | - | 3 | 2 |

| **MODULE-1** | **INTRODUCTION TO COMPUTER NETWORKS** | **24MCA14.1** | **8 Hours** |
|---|---|---|---|

Introduction, Applications, Requirements, Connectivity, Network Topology, Modes, Scale. Network Protocol Stack (TCP/IP and ISO-OSI), Physical Layer - Guided and Unguided Transmission Media, Digital Modulation Techniques (NRZ,NRZI,Manchester,4B/5B), Multiplexing (FDMA, TDMA, CDMA), Implementing Network Software, Performance, Mobile Telephone Systems (1G, 2G,3G, 4G).

| | |
|---|---|
| Self-study / Case Study / Applications | A case study on computer networking and its network configuration |
| Text Book | Text Book 1 : Chapter 1, 2 Text Book 2 : Chapter 1.1, 1.2, 1.3 |

| **MODULE-2** | **DATA LINK LAYER** | **24MCA14.2** | **8 Hours** |
|---|---|---|---|

Design Issues, Services to Network Layer, Framing, Error Detection and Correction Codes, Data Link Protocols for Noiseless Channels – Simplex, Stop-and-wait, Noisy Channels – Stop-and-wait ARQ, Go-back-N ARQ, Selective Repeat ARQ. Medium Access Sub-layer -Multiple Access Protocols and Examples: ALOHA, Pure ALOHA, Slotted ALOHA Protocol, Ethernet – 802.3 Frame Format, Carrier Sense Multiple Access (CSMA), Frame format of CSMA, Types of CSMA, CSMA with Collision Detection(CSMA/CD), Wireless LAN, Bluetooth, Spanning Tree.

| | |
|---|---|
| Self-study / Case Study / Applications | A case study on network security issues of data link layer |
| Text Book | Text Book 1 : Chapter 3, 4 Text Book 2 : Chapter 2.2, 2.4, 2.5, 2.6 |

| **MODULE-3** | **NETWORK LAYER** | **24MCA14.3** | **8 Hours** |
|---|---|---|---|

Functions, Design Issues, Routing Algorithms- Dijkstra Algorithm, Bellman-Ford Algorithm, Flood-Based Routing Algorithm, Multicasting Routing, Routing among Mobile Devices, Congestion Control Algorithms, Cause of Congestion, Congestion Control Methods - Open-Loop Congestion Control, Closed-Loop Congestion. Congestion Avoidance Mechanisms, Quality of Service -Leaky Bucket, Token Bucket, Internetworking - Significance, Global IP addresses.

| | |
|---|---|
| Text Book | Text Book 1 : Chapter 5, Text Book 2 : Chapter 3 |

| MODULE-4 | INTRODUCTION TO NS2 AND TRANSPORT LAYER | 24MCA14.4 | 8 Hours |
|---|---|---|---|
| Basics of NS2, Wired TCL Script Components and Parameters, Quality of Service - Tunneling, Fragmentation versions of IP - IPv4 and Ipv6, ARP (Address Resolution Protocol), DHCP (Dynamic Host Configuration Protocol), ICMP (Internet of Control Message Protocol). The Transport Layer - Elements of Transport Protocols, Connection Establishment - Two-Way Handshake, Connection and Release. | | | |
| Text Book | Text Book 1 : Chapter 6, Text Book 2 : Chapter 4.1.3, 4.4.2 | | |
| **MODULE-5** | **APPLICATION LAYER** | **24MCA14.5** | **8 Hours** |
| The Internet Transport Protocol-Functionality and Comparison of TCP and UDP, DNS - Structure, Message Format. Examples - Email, World Wide Web - Architecture, Working, Streaming Audio and Video and Content Delivery, FTP, TELNET. | | | |
| Text Book | Text Book 1 : Chapter 7, Text Book 2 : Chapter 9 | | |

**CIE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 4 | 3 |
| L2 | Understand | 10 | 4 | 3 |
| L3 | Apply | 5 | 3 | 2 |
| L4 | Analyze | 5 | 4 | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) "Computer Networks" 6th Edition, 2022 by Andrew S Tanenbaum, Nick Feamster, David J. Wetherall, ISBN: 9780137523214.
2) "Computer Networks: A Systems Approach, Sixth Edition, 2021", Larry L Peterson. ISBN: 978-0128182000.


**Reference Books:**


1) Computer Networks - Principles, Technologies and Protocols for Network Design, N Olifer, 2005, ISBN: 978-0470869826.
2) Computer Networking, James Kurose , Keith Ross, Pearson Education, 8th edition 2022, ISBN: 9780135928615.


**Web links and Video Lectures (e-Resources):**

- https://archive.nptel.ac.in/courses/106/105/106105183/
- https://onlinecourses.swayam2.ac.in/cec23_cs07/preview

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:**

- Video demonstration of latest technology in computer networks.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to write and execute networks related program. Organizing group wise discussions on various applications.

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## LINUX OPERATING SYSTEM AND SHELL SCRIPTING

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA15** | **CIE Marks** | **50** |
| **L:T:P:S** | **2:0:1:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+2** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA15.1 | Explain the fundamental concepts of operating systems, including their structure, components, and services. |
| 24MCA15.2 | Implement file operations and symbolic links. |
| 24MCA15.3 | Use control structures, test conditions and command line arguments to create utilities. |
| 24MCA15.4 | Examine the usage of regular expressions in simple and advanced filters. |
| 24MCA15.5 | Analyse the different memory allocation strategies and develop awk scripts. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA15.1 | 2 | - | - | - | - | - | - | - | 2 | - |
| 24MCA15.2 | 2 | - | - | - | - | - | - | - | 2 | - |
| 24MCA15.3 | - | 2 | 3 | 2 | - | - | - | - | 2 | - |
| 24MCA15.4 | 2 | 2 | 3 | 2 | - | - | - | - | 2 | - |
| 24MCA15.5 | 2 | 3 | - | 3 | - | - | - | - | 2 | - |

**MODULE-1** **INTRODUCTION TO OPERATING SYSTEM** **24MCA15.1** **7 Hours**

Introduction, System Components, Open-Source Operating Systems, Operating System Services, System Calls, Process Management- Process Structure, Process states, Types of Schedulers, Scheduling Criteria, Scheduling algorithms. Deadlock and Starvation- Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery. Linux Environment, Fundamental Commands. System Shell and User Shells.

**Laboratory Component:** **2 Hours**

1. *Execute basic Linux commands such as pwd, cd, ls, mkdir, rmdir, cp, mv, rm, cat, and observe their effects on the file system.*
2. *Write a shell script that, when executed, displays the message "Good Morning," "Good Afternoon," or "Good Evening," depending on the time at which the user logs in.*
3. *Write a shell script that accepts a path name and creates all the components in that path name as directories. For example, if the script is named mpc, then the command mpc a/b/c/d should create directories a, a/b, a/b/c, and a/b/c/d.*

| | |
|---|---|
| Self-study / Case Study / Applications | Install a Virtual Machine and Linux Operating system. Explore the usage of sudo commands for various installations. |
| Text Book | Text Book 1: Chapter 1.1-1.8, 2.1-2.4, 3.1-3.5, 5.1-5.3, 8.1-8.9 |

**MODULE-2** **LINUX FILE SYSTEM – STRUCTURE AND COMMANDS** **24MCA15.2** **7 Hours**

Linux System Architecture, Users in Linux Multiuser System, HOME Directory, File System Structure, File Naming Conventions, Relative Path and Absolute Path, File Management Commands - cd, mkdir, cp, mv, rm, rmdir, cat, File Attributes - ls, ls -l, ls -d, File Permissions, Directory Permissions, File Ownership, Changing Ownership and Group using chmod, umask, chown & chgrp, Changing File Modification and Access Times using touch, Hard Link, Symbolic Link, find command.

**Laboratory Component:** **2 Hours**

1. *Create a shell script to implement a terminal locking mechanism similar to the lock command. The script should prompt the user to enter a password, then prompt again to confirm the password. If the passwords match, the script should lock the terminal, requiring the correct password to unlock it. Use Linux file management commands to achieve this functionality.*
2. *Create a script file called file-properties that reads a file name entered by the user and outputs its properties.*
3. *Write a shell script that accepts valid login names as arguments and prints their corresponding home directories. If no arguments are specified, print a suitable error message.*

4. *Write a shell script that displays all the links to a file specified as the first argument to the script. The second argument, which is optional, can be used to specify the directory in which the search is to begin. If this second argument is not provided, the search will begin in the current working directory. In either case, the starting directory and all its subdirectories at all levels must be searched. The script does not need to include any error checking.*

| Text Book | Text Book 1: Chapter 20.1, Text Book 2: Chapter 1, 5 | | |
|---|---|---|---|
| **MODULE-3** | **SHELL PROGRAMMING** | **24MCA15.3** | **7 Hours** |

Introduction, Shell Variables, Shell Scripts, Reading Values, Positional Parameters, Command Line Arguments, exit Status of a Command, Logical Operators, Control Structures, Test Conditions, Evaluating Values, sleep, wait. Shell Programming- Assigning Values to Positional Parameters using set, shift, Output Redirection, Input Redirection, Shell Functions. Process Management Commands in Linux - ps, Running Jobs in Background, Introduction to Commands like nice, at and batch, and cron.

**Laboratory Component:** **2 Hours**

1. *Write a shell script that accepts two file names as arguments. It checks if the permissions for these files are identical. If the permissions are identical, output the common permissions; otherwise, output each file name followed by its permissions.*
2. *Write a shell script that takes a valid directory name as an argument, recursively descends into all the sub-directories, finds the maximum length of any file in that hierarchy, and writes this maximum value to the standard output.*
3. *Write a shell script that accepts a list of filenames as its arguments, counts the occurrences of each word present in the first argument file in the other argument files, and reports the counts.*

| Text Book | Text Book 2: Chapter 3.1, 3.3, 3.5, 3.7, 3.10 | | |
|---|---|---|---|
| **MODULE-4** | **SIMPLE FILTERS** | **24MCA15.4** | **7 Hours** |

Definition, Usage of filters – tr, cut, paste, grep, wc, head, tail, sort, more. Usage of Regular Expressions with grep and sed (stream editor), Advanced Filters- Simple awk Filtering, BEGIN and END sections, built-in variables, arrays, functions, control flow, looping, Develop Utilities using Filters.

**Laboratory Component:** **2 Hours**

1. *Write a shell script to display the calendar for the current month with the current date replaced by * or ** depending on whether the date has one digit or two digits.*
2. *Write a shell script that accepts a file name, starting line number, and ending line number as arguments and displays all the lines between the given line numbers.*
3. *Write a shell script that folds long lines into 40 columns. Any line that exceeds 40 characters must be broken after the 40th character, with a \ appended to indicate the line is folded, and processing should continue with the remaining text. The input should be supplied through a text file created by the user.*

| Self-study / Case Study / Applications | Suggest one utility that may be built using either Stream Editor (sed) or AWK script. |
|---|---|
| Text Book | Text Book 3: Chapter 1, 2 |

| **MODULE-5** | **LINUX MEMORY MANAGEMENT** | **24MCA15.5** | **7 Hours** |
|---|---|---|---|

Memory Types, Contiguous Memory Allocation, Algorithms – First Fit, Best Fit and Worst Fit, Internal Fragmentation, Non-Contiguous Memory Allocation - Virtual Memory, Paging, Segmentation, Page Replacement Algorithms- First in First Out, Least Recently Used, Optimal Page Replacement Algorithm, Secondary Storage - Disk Structure, Disk Scheduling, Disk Management.

**Laboratory Component:** **2 Hours**

1. *Write an awk script that accepts a date argument in the form of dd-mm-yy and displays it in the form of month, day, and year. The script should check the validity of the argument and, in case of an error, display a suitable message.*
2. *Write an awk script to delete duplicate lines from a text file while keeping the order of the original lines unchanged.*
3. *Write an awk script to find the total number of books sold in each discipline as well as the total number of books sold, using an associative array. For example: Electrical 34, Mechanical 67, Electrical 80, Computer Science 43, Mechanical 65, Civil 98, Computer Science 64.*

| Text Book | Text Book 3: Chapter 9.1-9.5, 10.1- 10.5, 11.8, 12.2,12.3, 13.1, 13.3 |
|---|---|

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | Lab |
| | | 25 | 05 | 20 |
| L1 | Remember | 5 | - | - |
| L2 | Understand | 5 | - | 5 |
| L3 | Apply | 10 | 3 | 10 |
| L4 | Analyze | 5 | 2 | 5 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | -- |
| L6 | Create | -- |

**Suggested Learning Resources:**

**Text Books:**


1) Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles –10th Edition, John Wiley &Sons Inc., 2021, ISBN: 9781119320913.
2) John Smith, Mastering Linux: A Comprehensive Guide to Linux Administration and Beyond– Tech. Publications Inc., 2023, ISBN: 9781789954272.
3) Arnold Robbins, Effective Awk Programming, O'Reilly Media Inc., 2015, ISBN: 9780596000707.


**Reference Books:**


1) Barrett, Daniel J. Efficient Linux at the Command Line. " O'Reilly Media, Inc.", 2022.
2) Miller, Scott Alan. Linux Administration Best Practices. Packt Publishing, 2022.
3) Linux: The Complete Reference, Sixth Edition, 1 July 2017, Richard Petersen, Mc Graw Hill.


**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/117106113
- https://onlinecourses.nptel.ac.in/noc21_cs72

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:**

- Team Activity- To compare performance of various process management and memory management algorithms.
- Hands-on: Development of new utilities in Linux using existing commands and utilities.

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## DATABASE MANAGEMENT SYSTEMS

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA16** | **CIE Marks** | **50** |
| **L:T:P:S** | **2:0:1:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+2** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA16.1 | Comprehend the fundamentals database system concept and architecture. |
| 24MCA16.2 | Illustrate Relational database design using ER-Modelling for various applications. |
| 24MCA16.3 | Apply the concepts of Relational Algebra using SQL. |
| 24MCA16.4 | Synthesize sophisticated queries to extract information from given Database using SQL. |
| 24MCA16.5 | Derive procedures in PL/SQL to extend functionality of Database applications. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA16.1 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| 24MCA16.2 | 3 | 2 | - | - | - | - | - | - | 3 | 2 |
| 24MCA16.3 | 3 | - | - | - | - | - | - | - | 3 | 2 |
| 24MCA16.4 | 3 | 3 | - | - | - | - | - | - | 3 | 2 |
| 24MCA16.5 | 3 | 3 | 1 | 2 | - | - | - | - | 3 | 2 |

| | | | |
|---|---|---|---|
| **MODULE-1** | **INTRODUCTION** | **24MCA16.1** | **7 Hours** |

Databases and Database Users-Database Characteristics, Actors/Workers, Advantages of using DBMS approach, Database System Concepts and Architecture - Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment-DBMS Component Modules, Classification of Database Management Systems, Relational Model Concepts-Domains, Attributes, Tuples, and Relations, Characteristics of Relations, Relational Model Notation.

**Laboratory Component:** **2 Hours**

1. *Exploration of basic commands in MySQL.*
2. *Exploration of data types in MySQL.*
3. *Construct relational model for employee and department schema.*

| | |
|---|---|
| Self-study / Case Study / Applications | **HANDS ON:** Database Applications. |
| Text Book | Text Book 1: Chapter 1 , Text Book 2: Chapter 1, 2 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **RELATIONAL MODEL AND DATA MODELING** | **24MCA16.2** | **7 Hours** |

Types of Constraints, Relational Database Schemas, Integrity, Referential Integrity and Foreign Keys, Update Operations, Transaction and Dealing with Constraint Violations. Data Modeling Using the Entity-Relationship (ER) Model-High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Naming Conventions and Design Issues in ER Diagrams, Relationship Types of Degree Higher than Two, Relational Database Design Using ER-to-Relational Mapping.

**Laboratory Component:** **2 Hours**

1. *Draw an ER diagram for Employee Management System using drawing tools.*
2. *Draw an ER diagram for Library Management System using drawing tools.*
3. *Draw an ER diagram for University Database System using drawing tools.*

| | |
|---|---|
| Self-study / Case Study / Applications | **HANDS ON:** Analyse the Keys and Constraints for *Tourism Management and Hotel Booking Systems*. |
| Text Book | Text Book 1: Chapter 2, 7, Text Book 2: Chapter 3, 7 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **RELATIONAL OPERATIONS** | **24MCA16.3** | **7 Hours** |

Unary Relational Operations-SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations-JOIN and DIVISION, Additional Relational Operations-Aggregate Functions and Grouping, Outer Join Operations, Examples of Queries in Relational Algebra, Basic SQL- SQL Data Definition

and Data Types-The CREATE TABLE Command in SQL, Attribute Data Types and Domains in SQL, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE and UPDATE Statements in SQL, Ambiguous Attribute Names, Aliasing, Renaming and Tuple Variables, Unspecified WHERE Clause and Use of the Asterisk, Substring Pattern Matching and Arithmetic Operators.

**Laboratory Component:** **2 Hours**

1. *Creating a table student with following information - Name of table: student, columns and data types - rollno number(6), name varchar(20), branch varchar(20)*
   - *Inserting data into the student table*
   - *Altering table by adding new column class varchar(20) Deleting a row from the table*
   - *Drop column branch*
   - *Alter table by changing the data type of rollno to number(8)*
   - *Delete all the data from student table*
   - *Delete the table*
2. *Create Sales table with the following fields( Sales No, Sales name, Branch, Sales amount, DOB)*
   - *Insert five records*
   - *Calculate total Sales amount in each branch*
   - *Calculate average Sales amount in each branch*
   - *Display all the salesmen, DOB who are born in the month of December as day in character format.*
3. *Write necessary query for the following*
   - *Create the CUSTOMERS table having with ID, NAME, GE,ADDRESS, SALARY as attribute.*
   - *Design a view from the CUSTOMERS table. This view would be used to have customer name and age from the CUSTOMERS table.*
   - *Create view cust As select NAME,AGE from CUSTOMER;*
   - *Display the content of view*

| Text Book | Text Book 1 : Chapter 3, 4, Text Book 2: Chapter 4, 6 | | |
|---|---|---|---|
| **MODULE-4** | **SQL RETRIEVAL QUERIES AND RELATIONAL DATABASE DESIGN** | **24MCA16.4** | **7 Hours** |

Complex SQL Retrieval Queries-Nested Queries, Tuples, and Set/Multiset Comparisons, Correlated Nested Queries, EXISTS and UNIQUE Functions in SQL, Joined Tables in SQL and Outer Joins, Aggregate Functions in SQL, Grouping, Views in SQL.

Database Design - Informal Design Guidelines for Relation Schemas, Functional Dependencies, 1NF, 2NF, 3NF, Boyce-Codd Normal Form.

**Laboratory Component:** **2 Hours**

1. *An Enterprise wishes to maintain a database to automate its operations. Enterprise is divided into certain departments and each department consists of employees*
   - *Update the employee salary by 15%, whose experience is greater than 10 years*
   - *Delete the employees, who completed 30 years of service*
   - *Display the manager who is having maximum number of employees working under him*
   - *Create a view, which contain employee names and their manager*
2. *Write an SQL query to find the total revenue, average revenue, minimum revenue, maximum revenue, and number of orders for each product in an e-commerce database. The database contains two tables: Orders and Order Details. The Orders table has the columns Order ID, Order Date, and Customer ID, and the Order Details table has the columns Order Detail ID, Order ID, Product ID, Quantity, and Unit Price.*
3. *Write an SQL query that demonstrates the use of various types of joins (INNER JOIN, LEFT JOIN, RIGHT JOIN, and FULL OUTER JOIN) using the Products and Order Details tables. Each type of join serves a different purpose in combining the data from the two tables.*

| Text Book | Text Book 1: Chapter 8, Text Book 2: Chapter 5, 15 | | |
|---|---|---|---|
| **MODULE-5** | **INTRODUCTION TO PL/SQL** | **24MCA16.5** | **7 Hours** |

Basics of PL/SQL- Identifiers, Delimiters, Comments, Data Types, Basic Syntax, Control Statements, Loops-Labeling a PL/SQL Loop, Loop Control Statements, Cursors- Implicit Cursor, Explicit Cursors- Declaring the Cursor, Opening the Cursor, Fetching the Cursor, Closing the Cursor. Procedures- Creating a Procedure, Executing a Standalone Procedure, Deleting a Standalone Procedure, Parameter Modes in PL/SQL Subprograms, Functions-Creating a Function, Calling a Function, PL/SQL Recursive Functions, Exceptions-Syntax for Exception Handling, Raising Exceptions, User-defined Exceptions, Pre-defined Exceptions, Triggers-Benefits of Triggers, Working with Triggers.

**Laboratory Component:** **2 Hours**

1. *Write a PL/SQL program to demonstrate Cursors.*
2. *Write PL/SQL queries to create Procedures.*
3. *Write a PL/SQL program to demonstrate Functions.*

| Text Book | Text Book 3: Chapter 4, 5, 6, 9, 11, 13 |
|---|---|

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Assessment | Lab |
| | | 25 | 5 | 20 |
| L1 | Remember | 5 | 2 | - |
| L2 | Understand | 10 | 3 | - |
| L3 | Apply | 5 | - | 20 |
| L4 | Analyze | 5 | - | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources**

**Text Books:**


1) Abraham Silberschatz, Henry F Korth, S. Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill, 2021,ISBN: 9780078022159.
2) Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2017, ISBN: 9789332582705.
3) Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", Sixth Edition, ORACLE Press, 2023, ISBN: 978-0138062835.


**Reference Books:**


1) Carlos Coronel, Stephen Morris, Peter Rob, "Database Principles: Fundamentals of Design, Implementation and Management", 10th Edition, Cengage India Private Limited, 2014, ISBN: 9788131525937.
2) Niraj Gupta, "Oracle SQL and PL/SQL", Createspace Independent Pub, 2015, ISBN: 9781542901444.


**Web links and Video Lectures (e-Resources):**

- www.scaler.com/topics/dbms
- https://www.coursera.org/learn/database-structures-and-management-with-mysql
- https://onlinecourses.swayam2.ac.in/ini24_cs01/preview

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Group discussion on designing a database for a Web Application.
- Student presentations on UML diagrams.

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## PROGRAMMING WITH C LAB

| | | | |
|---|---|---|---|
| **Course Code** | **24MCAL17** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:1:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **1** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCAL17.1 | Predict the outcomes of various control structures in a C program. |
| 24MCAL17.2 | Use different data types in arrays to understand their impact on memory allocation and manipulation. |
| 24MCAL17.3 | Apply coding techniques to achieve modularity. |
| 24MCAL17.4 | Examine real-world problems to determine the usage of user-defined data types. |
| 24MCAL17.5 | Identify the usage of pointers and the basic operations in file handling. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCAL17.1 | 3 | - | - | - | - | - | - | - | - | 3 |
| 24MCAL17.2 | 3 | 1 | 1 | - | - | - | - | - | - | 3 |
| 24MCAL17.3 | 3 | 1 | 1 | - | - | - | - | - | - | 3 |
| 24MCAL17.4 | 3 | 1 | 1 | - | - | - | - | - | - | 3 |
| 24MCAL17.5 | 3 | 1 | 1 | - | - | - | - | - | - | 3 |

| Exp. No. / Pgm. No. | List of Experiments / Programs | Hours | Cos |
|---|---|---|---|
| | **Prerequisite Experiments / Programs / Demo** | | |
| | • Installation of software/compiler<br>• Demonstration of writing, compiling and executing program in C<br>• Simple practice exercises. | 2 | NA |
| | **PART-A** | | |
| 1 | • Write a program to check whether a year entered by the user is a leap year or not.<br>• Write a program to determine whether a character entered by the user is a vowel or consonant.<br>• Write a program to check whether a given number is zero, positive or negative. | 2 | 24MCAL17.1 |
| 2 | • Write a program to find the maximum and minimum of three numbers using nested if-else.<br>• Write a program to implement a simple calculator using switch case where the user can enter two numbers and choose an operation (+, -, *, /).<br>• Write a program to display the day of the week corresponding to a given number (1 for Sunday, 2 for Monday, etc.) using switch case. | 2 | 24MCAL17.1 |
| 3 | • Write a program to print all Even numbers between two integers.<br>• Write a program to print the multiplication table of a number up to a certain range. | 2 | 24MCAL17.1 |
| 4 | • Write a program to print all prime numbers between two given integers start and end.<br>• Write a program to print first N Fibonacci numbers. | 2 | 24MCAL17.1 |

| | | | |
|---|---|---|---|
| | • Write a program to print the following pattern using nested loops:<br>*<br>***<br>*****<br>*******<br>********* | | |
| 5 | • Write a C program to perform addition or subtraction on two matrices.<br>• Write a C program to perform multiplication on two matrices. | 2 | 24MCAL17.2 |
| 6 | • Write a C program to sort an array of integers in ascending order.<br>• Write a C program to search an element in an array. | 2 | 24MCAL17.2 |
| **PART-B** | | | |
| 7 | • Write a C program to find the length of a string without using standard library function.<br>• Write a C program to concatenate two strings without using standard library function. | 2 | 24MCAL17.2 |
| 8 | • Write a C program to reverse a given string without using standard library function.<br>• Write a C program to check if a given string is a palindrome or not without using standard library function. | 2 | 24MCAL17.2 |
| 9 | • Write a C program to find the sum and average of elements in an array using a function.<br>• Write a C program to calculate the factorial of a number N using recursive functions. | 2 | 24MCAL17.3 |
| 10 | • Define a user-defined datatype 'Student' using struct keyword. The various components of the datatype areroll_number (integer), name (string of maximum 50 characters) and marks (float). Write a program to create an array of 'Student' datatype, input data for N students and display details of the students with marks above a certain threshold. | 2 | 24MCAL17.4 |
| 11 | • Write a C program to swap two integers using pointers. | 2 | 24MCAL17.5 |
| 12 | • Write a program to copy one file content to another file without using inbuilt functions. | 2 | 24MCAL17.5 |
| **PART-C**<br>**Beyond Syllabus Virtual Lab Content**<br>**(To be done during Lab but not to be included for CIE or SEE)** | | | |
| 1. To define functions and call them with appropriate parameters- https://cse02-iiith.vlabs.ac.in/exp/functions/<br>2. To apply problem solving approach using recursive procedures- https://cse02-iiith.vlabs.ac.in/exp/cp-recursion/<br>3. To understand how to use structures as a compound data type- https://cse02-iiith.vlabs.ac.in/exp/structures/ | | | |

**CIE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Test (s) | Weekly Assessment |
|---|---|---|---|
| | | **40** | **10** |
| **L1** | **Remember** | - | - |
| **L2** | **Understand** | 10 | 4 |
| **L3** | **Apply** | 20 | 4 |
| **L4** | **Analyze** | 10 | 2 |
| **L5** | **Evaluate** | - | - |
| **L6** | **Create** | - | - |

**SEE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| **L1** | **Remember** | **5** |
| **L2** | **Understand** | **10** |
| **L3** | **Apply** | **20** |
| **L4** | **Analyze** | **10** |
| **L5** | **Evaluate** | **-** |
| **L6** | **Create** | **5** |

**Suggested Learning Resources:**

**Reference Books:**


1. E. Balaguruswamy, "Programming in ANSI C", McGrawHill Publishers, 9th Edition, 2024, ISBN: 13-978-93-5532-672-0.
2. V Rajaraman: Computer Programming in C, PHI, 2019, ISBN: 9789388028332.
3. Peter Norton, "Introduction to Computers", 7th Edition, McGraw Hill Education, 2017, ISBN-10: 9789387067028.


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| OBJECT ORIENTED PROGRAMMING WITH JAVA LAB | | | |
|---|---|---|---|
| **Course Code** | **24MCAL18** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:1:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **1** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCAL18.1 | Write basic Java program using classes and objects with proper syntax and semantics. |
| 24MCAL18.2 | Create an application for manipulating string and array elements. |
| 24MCAL18.3 | Create an application using Inheritance, interfaces and packages. |
| 24MCAL18.4 | Apply the concepts of Multithreading and Exception Handling to develop efficient and error free codes. |
| 24MCAL18.5 | Develop programs using collections and AWT components. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCAL18.1 | 3 | 1 | - | 1 | - | - | - | - | 2 | 2 |
| 24MCAL18.2 | 3 | 2 | - | 3 | - | - | - | - | 2 | 2 |
| 24MCAL18.3 | 3 | 2 | - | 3 | - | - | - | - | 2 | 2 |
| 24MCAL18.4 | 3 | 2 | - | 3 | - | - | - | - | 2 | 2 |
| 24MCAL18.5 | 3 | 3 | - | 3 | - | - | - | - | 2 | 2 |

| Pgm. No. | List of Programs | Hours | COs |
|---|---|---|---|
| | **Prerequisite Programs / Demo** | | |
| | • Core JAVA Programming<br>• Basics of Core JAVA Programming | 2 | NA |
| | **PART-A** | | |
| 1 | Write a Java Program to display employee pay slip using Class, Object and Method. | 2 | 24MCAL18.1 |
| 2 | Write a Java Program to demonstrate Constructor Overloading and Method Overloading in one single Program. | 2 | 24MCAL18.1 |
| 3 | Write a Java program to sort for an element in a given list of elements using Bubble Sort. | 2 | 24MCAL18.2 |
| 4 | Write a Menu based Java program to implement string Tokenizer, any 5 String and StringBuffer methods. | 2 | 24MCAL18.2 |
| 5 | Write a Java Program to handle simple Bank transaction using Inheritance. | 2 | 24MCAL18.3 |
| 6 | Simple Program on Java for the implementation of Multiple inheritance using interfaces to calculate the area of a rectangle and triangle. | 2 | 24MCAL18.3 |
| | **PART-B** | | |
| 7 | Write a Java program to demonstrate Multithreading with Synchronization. | 2 | 24MCAL18.4 |

| | | | |
|---|---|---|---|
| 8 | Write a Java program to create a package named shape, to create some classes in the package representing some common shapes like Square, Triangle, and Circle and import and compile these classes in other program. | 2 | 24MCAL18.4 |
| 9 | Write a program to demonstrate the implementation of Exception Handling in Java. | 2 | 24MCAL18.4 |
| 10 | Write a program to implement Queue from Java Collection. | 2 | 24MCAL18.5 |
| 11 | Write a Java program to implement Linked List from Java Collection. | 2 | 24MCAL18.5 |
| 12 | Write a Java program to create a student registration page using AWT components. | 2 | 24MCAL18.5 |

**PART-C**

**Beyond Syllabus Virtual Lab Content**

**(To be done during Lab but not to be included for CIE or SEE)**

- https://java-iitd.vlabs.ac.in/exp/abstraction/
- https://java-iitd.vlabs.ac.in/exp/encapsulation/

**CIE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Test (s) | Weekly Assessment |
|---|---|---|---|
| | | 40 | 10 |
| L1 | Remember | 10 | - |
| L2 | Understand | 10 | 5 |
| L3 | Apply | 10 | 5 |
| L4 | Analyze | 10 | - |
| L5 | Evaluate | - | - |
| L6 | Create | - | - |

**SEE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | 5 |

**Suggested Learning Resources:**

**Reference Books:**


1) First Java, Kathy Sierra & Bert Bates, Shroff/O'Reilly Publication, 3rd Edition 2022.
2) Core Java Volume I – Fundamentals, Cay S. Horstmann, Prentice Hall, 12th Edition May 2021.
3) Java 6 Programming Black Book, Dreamtech Press, 2012.


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**(Mandatory Learning Course)**
**A bridge course for graduates joined for MCA Programme without study of Mathematics at 10+2 level or at Graduation level**

## FOUNDATION MATHEMATICS FOR COMPUTER APPLICATIONS

| | | | |
|---|---|---|---|
| **Course Code** | **24MATC19*** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:0:0** | **SEE Marks** | **-** |
| **Hrs. / Week** | **3** | **Total Marks** | **50** |
| **Credits** | **00** | **Exam Hours** | **-** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MATC19.1 | Widen the knowledge of Basic concepts in Set Theory and Apply the fundamentals of set theory and Relations to the given problem. |
| 24MATC19.2 | Understand mathematical reasoning to read, comprehend and construct mathematical arguments. |
| 24MATC19.3 | Understand the Basic Concepts in Matrices and Formulate the problems in Matrix expression. |
| 24MATC19.4 | Determine the sum of the first n terms of an arithmetic and Geometric series. |
| 24MATC19.5 | Get the basic concepts of probability and find the probability of simple and compound events. |

**Mapping of Course Outcomes to Program Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MATC19.1 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC19.2 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC19.3 | 3 | 3 | - | - | - | - | - | - | 2 | - |
| 24MATC19.4 | 3 | 2 | 2 | - | - | - | - | - | 2 | - |
| 24MATC19.5 | 3 | 2 | 2 | - | - | - | - | - | 2 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **SET THEORY** | **24MATC19.1** | **8 Hours** |

Introduction. Representation of Sets, Types of Sets, Finite Set, Infinite Set, Equivalent Set, Disjoint Set, Subset, Power Set. Venn Diagram. Set Operations: Union, Intersection, Complement of a Set, Difference, Symmetric Difference. Laws of Set Theory. Cartesian Product of Sets, Relations and Properties.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 2 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **LOGIC AND PROPOSITIONS** | **24MATC19.2** | **8 Hours** |

Logic Statement, Propositions, Connectives, Basic Logic Operations: Conjunction, Disjunction, Negation, Implication and Double Implication. Truth Table, Logical Equivalence/Equivalent Statements, Tautologies and Contradictions.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **MATRICES AND DETERMINANTS** | **24MATC19.3** | **8 Hours** |

Matrix Introduction, Types of Matrices, Scalar Multiplication, Addition of Matrices, Product of Matrices. Transpose of a Matrix, Symmetric and Skew Symmetric Matrix, Rank of a Matrix, and Determinant of a Matrix. Singular Matrix.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **SEQUENCE AND SERIES** | **24MATC19.4** | **8 Hours** |

Introduction, Sequences, Series, Arithmetic Progression, Sum of Finite Number of Terms in A.P, Arithmetic Means, Geometric Progression, Sum to N Terms of G.P, Geometric Mean, Relation Between A.M and G.M.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **PROBABILITY THEORY** | **24MATC19.5** | **8 Hours** |

Probability: Introduction, Random Experiments, Sample Space, Events and Algebra of Events. Definitions of Probability – Classical, and Axiomatic. Conditional Probability, Laws of Addition and Multiplication, Independent Events, Theorem of Total Probability, Bayes' Theorem and its Applications.

| Text Book | Text Book 2: Chapter 1, 2 & 3 |
|---|---|

**CIE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | **25** | **15** | **10** |
| **L1** | **Remember** | 10 | 5 | 5 |
| **L2** | **Understand** | 10 | 5 | 5 |
| **L3** | **Apply** | 5 | 5 | - |
| **L4** | **Analyze** | - | - | - |
| **L5** | **Evaluate** | - | - | - |
| **L6** | **Create** | - | - | - |

**Suggested Learning Resources:**

**Text Books:**

1) Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications, 7th edition ISBN: 978-0077418939.
2) Walpole Myers Ye "Probability and Statistics for engineers and Scientist" Pearson Education, 8th edition ISBN: 978-0132047678.

**Reference Books:**

1) Richard A Johnson and C. B Gupta "Probability and statistics for engineers" Pearson Education.
2) J.K Sharma "Discrete Mathematics", Mac Millan Publishers India, 3rd edition,2011.
3) Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2015.

**Web links and Video Lectures (e-Resources):**

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU EDUSAT PROGRAMME-20

**Activity-Based Learning (Suggested Activities in Class)/Practical Based Learning:**

- Quiz
- Group assignment
- Seminars

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# SECOND SEMESTER
# MCA SYLLABUS
# (2024-25)

## DATA STRUCTURES

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA21** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA21.1 | Discuss fundamentals of data structures, arrays with sorting and searching techniques. |
| 24MCA21.2 | Apply stacks and recursion in problem solving. |
| 24MCA21.3 | Use operations of queues in computing applications. |
| 24MCA21.4 | Analyze different types of linked lists. |
| 24MCA21.5 | Analyze the operations of different types of trees and graph representations. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA21.1 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA21.2 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA21.3 | 3 | - | 1 | - | - | - | - | - | 3 | - |
| 24MCA21.4 | 3 | - | 1 | - | - | - | - | - | 3 | - |
| 24MCA21.5 | 3 | 2 | 1 | - | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **INTRODUCTION TO DATA STRUCTURES, SORTING AND SEARCHING TECHNIQUES** | **24MCA21.1** | **8 Hours** |

Data Structures - Definition, Need, Classification and Applications. Static Memory Allocation with Operations, Sorting Algorithms - Selection Sort, Bubble Sort, Merge Sort, Shell Sort, Radix Sort. Searching Techniques - Linear Search Binary Search, Indexed Sequential Search, Hashing.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1, 6, 7 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **STACKS AND RECURSION** | **24MCA21.2** | **8 Hours** |

Array Representation of Stack, Operations on a Stack, Applications of Stacks - Processing of Function Calls, Reversing a String, Checking Correctness of Well-Formed Parentheses. Conversion From Infix to Postfix, Evaluation of a Postfix Expression. Recursion-Recursive Definition and Processes, Designing the Recursive Functions, Examples on Recursion -Factorial of a Number, Fibonacci Numbers, Towers of Hanoi Problem.

| | |
|---|---|
| Self-study / Case Study / Applications | Case studies for demonstrating the use of stacks in recursive applications. |
| Text Book | Text Book 1: Chapter 2, 3 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **QUEUES AND DYNAMIC MEMORY ALLOCATION** | **24MCA21.3** | **8 Hours** |

Array Representation of Queues, Comparing Queues with Stacks, Primitive Operations of Queue with Implementation; Other Types of Queues with Operations - Circular Queues, Double Ended Queues, Applications of Queues, Priority Queues – Min-Heap, Max-Heap, Applications of Priority Queues – Job Scheduling, Dijkstra's Algorithm, Basics of Dynamic Memory Allocation, Static vs. Dynamic Memory Allocation, Garbage Collection.

| | |
|---|---|
| Self-study / Case Study / Applications | Case studies for demonstrating the use of queues in real time applications. |
| Text Book | Text Book 1: Chapter 4.1 to 4.4 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **LINKED LISTS** | **24MCA21.4** | **8 Hours** |

Arrays vs. Linked Lists, Types of Lists – Single Linked List, Circular Single Linked List, Double Linked List, Circular Double Linked Lists, Operations on Lists–Insertion, Deletion, Traversal, Stack and Queue Implementation using Lists, Applications of Lists.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 4.5, 4.6 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **TREES AND GRAPHS** | **24MCA21.5** | **8 Hours** |

Introduction, Applications, Importance of Trees, Basic Tree Concepts and Terminologies, Binary Trees, Complete Binary Trees, Heaps, Binary Search Tree, Traversals – In-order, Pre-order, Post-order, AVL Trees, Heaps, Red-Black Tree, Threaded Binary Trees, Basic Terminologies in Graphs, Graph Representations –

| | |
|---|---|
| Adjacency Matrix, Adjacency Lists, Traversals of Graphs. | |
| Text Book | Text Book 2: Chapter 1, 2.1 to 2.5 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 3 | 3 |
| L2 | Understand | 5 | 4 | 3 |
| L3 | Apply | 5 | 4 | 2 |
| L4 | Analyze | 10 | 4 | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 10 |
| L4 | Analyze | 20 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures Using C and C++", Pearson Education India; 2nd Edition, 2015, ISBN : 978-9332549319.
2) Anuradha A. Puntambekar, "Advanced Data Structures", Amazon Digital Services LLC - KDP Print US, 2020, ISBN: 9789333223836.


**Reference Books:**


1) Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Education. Ltd., 4th Edition, 2014, ISBN: 978-0-13-2847377.
2) Michael T. Goodrich, R. Tamassia and David M. Mount, "Data structures and Algorithms in C++", John Wiley and Sons, 2nd Edition, 2011, ISBN-13 978-0-470-38327-8.


**Web links and Video Lectures (e-Resources)**

- https://www.coursera.org/learn/data-structures
- https://nptel.ac.in/courses/106106127
- https://nptel.ac.in/courses/106102064

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of sorting algorithms
- Demonstration of recursive algorithms
- Case studies on graph traversals

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## ADVANCED JAVA

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA22** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA22.1 | Discuss the fundamentals of Java Swing in creating Java GUI application. |
| 24MCA22.2 | Develop programs to implement database operations using JDBC. |
| 24MCA22.3 | Create dynamic web pages using Servlet. |
| 24MCA22.4 | Design and develop dynamic web pages using Java server pages and Java Beans. |
| 24MCA22.5 | Use Java beans and JSTL to build web applications. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA22.1 | - | 3 | 3 | - | - | - | - | - | 3 | - |
| 24MCA22.2 | - | 3 | 3 | - | - | - | - | - | 3 | - |
| 24MCA22.3 | - | 3 | 3 | - | - | - | - | - | 3 | - |
| 24MCA22.4 | - | 3 | 3 | 1 | - | - | - | - | 3 | - |
| 24MCA22.5 | - | 3 | 3 | 1 | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **SWING** | **24MCA22.1** | **8 Hours** |

Fundamentals, Components-Text Field, Label, Text Area, Password Field, Combo Box, Table, List, Option Pane, Scrollbar, Menu, Color Chooser, Radio Button, Checkbox. Components, Layout Managers, Event Handling.

| | |
|---|---|
| Text Book | Text Book 3: Chapter 15, 16, 17, 18, 19, 20, 21, 22 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **JAVA DATABASE CONNECTIVITY (JDBC)** | **24MCA22.2** | **8 Hours** |

Basic concepts, Driver Types, Packages, Connectivity steps, Database Connection, Statement Objects, Result Set, Metadata, Data Types, Exceptions. JDBC and Embedded SQL- Tables, CRUD operations, Store and retrieve images.

| | |
|---|---|
| Self-study / Case Study / Applications | • Installation of Web frame work<br>• Develop an interactive GUI application to demonstrate the swing and JDBC. |
| Text Book | Text Book 2: Chapter 5, 6, 7 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **SERVLETS** | **24MCA22.3** | **8 Hours** |

Introduction, Uses of Servlet, Servlet Architecture, Web Container, The Servlet Life Cycle, Servlet API, Handling HTTP GET and POST Request, Exceptions, Servlet Config, Servlet Context, Cookies, Session Tracking, Servlet with JDBC.

| | |
|---|---|
| Text Book | Text Book 2: Chapter 10, Text Book 1: 4, 8, 9 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **JAVA SERVER PAGES (JSP)** | **24MCA22.4** | **8 Hours** |

Introduction, Advantages of JSP, JSP Architecture, JSP life Cycle, Developing First JSP, Implicit Objects, JSP Scripting Elements-Directives, Declaratives, Scriplets, Expressions, Implicit Variables, Page Directives, JSP action tags, JSP with JDBC. Java Beans- Advantages of Java Beans, The Java Beans API. A Bean Example, JSP with Java Beans.

| | |
|---|---|
| Self-study / Case Study / Applications | Develop an interactive web application to demonstrate the Servlet and JSP. |
| Text Book | Text Book 2: Chapter 11, Text Book 1: 12 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **JAVA STANDARD TAG LIBRARY (JSTL)** | **24MCA22.5** | **8 Hours** |

Why you should use the JSTL, JSTL Expression Language, Core Tags, Formatting tags, SQL tags, XML tags, Function tags, custom tag Libraries: why custom Tags, Tag Library basics, how are tags being used, Tag library Descriptors (TLDs), simple JSP 2.0 custom tags.

| | |
|---|---|
| Text Book | Text Book 2: Chapter 12 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 3 | 2 |
| L2 | Understand | 5 | 4 | 2 |
| L3 | Apply | 10 | 4 | 3 |
| L4 | Analyze | 5 | 4 | 3 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Core Servlets and Java Server Pages. Volume1: Core Technologies, Marty Hall, Larry Brown, Prentice Hall, 2ndEdition, 2013, ISBN 10: 0130092290 ISBN: 13-9780130092298.
2) J2EE: The Complete Reference, by Jim Keogh, McGraw Hill Education, 2017, ISBN: 10-0070529124.
3) Java6 Programming Black Book, Dreamtech Press, 2018, ISBN: 10-9788177227369.


**Reference Books:**


1) Developing Enterprise Java Components. Enterprise JavaBeans 3.1.O'Reilly. Andrew Lee Rubinger, Bill Burke, O'Reilly Media, 2010, ISBN: 9781449396961.
2) EJB 3 Developer Guide, A practical guide for developers and architects to the Enterprise Java Beans Standard, Michael Sikora, Shroff Publishers & Distributors PVT LTD. July 2008, ISBN: 9788184045307.


**Web links and Video Lectures (e-Resources)**

- https://www.geeksforgeeks.org/introduction-java-servlets/
- https://www.javatpoint.com/java-jdbc
- https://www.tutorialspoint.com/jsp
- https://www.geeksforgeeks.org/introduction-to-hibernate-framework/

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Video demonstration of latest technologies in Java.
- Expert talk & Seminars

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## DESIGN AND ANALYSIS OF ALGORITHMS

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA23** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA23.1 | Discuss fundamental concepts and terminology related to algorithms. |
| 24MCA23.2 | Explain basic algorithm design techniques and their applications. |
| 24MCA23.3 | Use algorithm design techniques to solve standard problems. |
| 24MCA23.4 | Characterize the features of various graphical problems with the help of a suitable technique. |
| 24MCA23.5 | Evaluate the limitations of algorithms and approaches to solve them. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA23.1 | 2 | 3 | - | - | - | - | - | - | 3 | - |
| 24MCA23.2 | 2 | 3 | - | - | - | - | - | - | 3 | - |
| 24MCA23.3 | 2 | 3 | - | - | - | - | - | - | 3 | - |
| 24MCA23.4 | 2 | 3 | - | - | - | - | - | - | 3 | - |
| 24MCA23.5 | 2 | 3 | - | - | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **INTRODUCTION AND ANALYSIS** | **24MCA23.1** | **9 Hours** |

Notion of Algorithm, Fundamental of Algorithmic Problem Solving, Important Problem Types, Basics of data structures. Fundamentals of the Analysis of Algorithm Efficiency- Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Recursive and Non-recursive Algorithms, Examples.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1, 2 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **BRUTE FORCE AND DIVIDE AND CONQUER** | **24MCA23.2** | **9 Hours** |

Selection Sort, Bubble Sort, String Matching, Exhaustive Search. Divide and Conquer- Merge sort, Quick sort, Binary Search, Binary Tree Traversals and Related Properties, Multiplication of Large Integers.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 3, 4 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **DECREASE AND CONQUER AND SPACE AND TIME TRADEOFFS** | **24MCA23.3** | **9 Hours** |

Insertion Sort, Depth - First and Breadth-First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects, Decrease by a Constant Factor Algorithms.
Space and Time Tradeoffs - Sorting by Counting, Input Enhancement in String Matching using Horspool's Algorithm, Hashing, B-Trees.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 5, 7 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE** | **24MCA23.4** | **9 Hours** |

Dynamic Programming - Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, Knapsack Problem. Greedy Technique - Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.

| | |
|---|---|
| Skill Development Activities | Real time algorithms to be designed in the field of computer networks by using Greedy Technique. |
| Text Book | Text Book 1: Chapter 8, 9 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **LIMITATIONS AND COPING WITH THE LIMITATIONS OF ALGORITHM POWER** | **24MCA23.5** | **9 Hours** |

Introduction, Lower Bound Arguments, Decision Trees, P, NP and NP-complete Problems. Coping with the Limitations of Algorithm Power- Backtracking, N-Queens Problem, Hamiltonian Circuit Problem, Subset-Sum Problem. Branch-and-Bound -Knapsack problem, Travelling Salesman Problem, Assignment problem.

| | |
|---|---|
| Skill Development Activities | Comparison analysis can be done based on both techniques by using real time applications. |
| Text Book | Text Book 1: Chapter 11, 12 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 5 | 5 |
| L2 | Understand | 10 | 5 | 5 |
| L3 | Apply | 5 | 3 | - |
| L4 | Analyze | 5 | 2 | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Book:**


1) Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson Education, 3rd Edition, 2021, ISBN: 9780137541133.


**Reference Books:**


1) Design and Analysis of Algorithms, Sandeep Sen, Amit Kumar, Cambridge University Press, 2019, ISBN: 978110849682.
2) Design and Analysis of Algorithms, Parag H. Dave, Pearson Education, 200, ISBN: 9788177585957.
3) Introduction to Algorithms, Thomas H. Cormen, Charles E.Leiserson, Ronal L.Rivest, Clifford Stein, MIT Press, 2001, ISBN: 9780262032933.
4) Algorithms: Design and Analysis, Sushil C. Dimri, Preeti Malik, Mangey Ram, De Gruyter Publications, 2021, ISBN: 9783110693751.
5) Fundamentals of Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S, Galgotia Publications, 2nd Edition, ISBN: 9788175152571.


**Web links and Video Lectures (e-Resources)**

- https://nptel.ac.in/courses/106101060
- https://onlinecourses.nptel.ac.in/noc19_cs47/preview
- https://www.coursera.org/specializations/algorithms

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Examining the performance of sorting algorithms with their implications.
- Examining the applications of Dijkstra's algorithm in computer networks.

****

## PROFESSIONAL ELECTIVES -1
## CLOUD COMPUTING

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA241** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA241.1 | Discuss scalable computing trends and paradigms. |
| 24MCA241.2 | Explain virtualization techniques and their role in cloud computing. |
| 24MCA241.3 | Compare the services offered by public cloud platforms. |
| 24MCA241.4 | Examine the different public cloud platforms and its features. |
| 24MCA241.5 | Analyze the various cloud programming models and apply them to solve problems in a cloud environment. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA241.1 | - | - | - | - | - | - | - | - | 3 | - |
| 24MCA241.2 | - | 3 | 1 | - | - | - | - | - | 3 | - |
| 24MCA241.3 | - | 2 | - | 3 | - | - | - | - | 3 | - |
| 24MCA241.4 | - | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA241.5 | 3 | 2 | - | 3 | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **DISTRIBUTED SYSTEM MODELS AND ENABLING TECHNOLOGIES** | **24MCA241.1** | **8 Hours** |

Scalable Computing Service, Scalable Computing Trends & New Paradigms, Internet of Things and Cyber-Physical Systems. Technologies for network based systems. System Models for Distributed and Cloud Computing- Clusters of Cooperative Computers, Grid Computing Infrastructures, Peer-to-Peer Network Families, Cloud Computing over the Internet.
Software Environments for Distributed Systems and Clouds- Service-Oriented Architecture (SOA), Parallel & Distributed Programming Models, Cloud Based Services and Applications.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1.5 Text Book 3: Chapter 1.1 to 1.4 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **VIRTUALIZATION AND CLOUD PLATFORM ARCHITECTURE** | **24MCA241.2** | **8 Hours** |

Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples: Xen- Para Virtualization, VMware- Full Virtualization, Microsoft Hyper-V.
Cloud Computing and Service Models- Public, Private, and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies, Infrastructure as a Service (IaaS), Platform and Software as a Service (PaaS, SaaS). Architectural Design of Compute and Storage Clouds- A Generic Cloud Architecture Design, Layered Cloud Architectural Development, Architectural Design Challenges.

| | |
|---|---|
| Self-study / Case Study / Applications | **Hands on:** Creating a word document and store on the cloud. |
| Text Book | Text Book 2: Chapter 3.1 to 3.6, Text Book 3: Chapter 4.1, 4.3 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **PUBLIC CLOUD PLATFORMS** | **24MCA241.3** | **8 Hours** |

GAE, AWS, and Azure- Public Clouds and Service Offerings, Google App Engine (GAE), Amazon Web Service (AWS), Microsoft Windows Azure.
Inter-Cloud Resource Management- Extended Cloud Computing Services, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources.
Cloud Security and Trust Management- Cloud Security Defense Strategies, Distributed Intrusion, Anomaly Detection, Data and Software Protection Techniques.

| | |
|---|---|
| Self-study / Case Study / Applications | **Hands on:** Creating an account in AWS and working with AWS, Launching an Instance with AMI. |
| Text Book | Text Book 3: Chapter 4.4, 4.5, 4.6 |

| MODULE-4 | CLOUD PROGRAMMING | 24MCA241.4 | 8 Hours |
|---|---|---|---|
| Features of Cloud and Grid Platforms- Cloud Capabilities and Platform Features, Traditional Features Common to Grids and Clouds, Data Features and Databases, Programming and Runtime Support. Parallel and Distributed Programming Paradigms- Parallel Computing and Programming Paradigms, Map Reduce, Hadoop Library from Apache. | | | |
| Self-study / Case Study / Applications | **Hands on:** Install a C compiler on the virtual machine and execute sample programs. | | |
| Text Book | Text Book 3: Chapter 6.1, 6.2 | | |
| **MODULE-5** | **PROGRAMMING SUPPORT OF GOOGLE APP ENGINE** | **24MCA241.5** | **8 Hours** |
| Google File System (GFS), Big Table, Google's NoSQL System, Chubby, Google's Distributed Lock Service. Programming on Amazon EC2, Amazon Simple Storage Service S3, Amazon Elastic Block Store (EBS) and SimpleDB, Emerging Cloud Software Environment- Open Source Eucalyptus and Nimbus, Open Nebula and Open Stack. | | | |
| Self-study / Case Study / Applications | **Hands on:** Installation and working of Google App Engine. | | |
| Text Book | Text Book 3: Chapter 6.3, 6.4, 6.5 | | |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | - | 5 |
| L2 | Understand | 5 | 5 | 5 |
| L3 | Apply | 10 | 5 | - |
| L4 | Analyze | 5 | 5 | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | -- |
| L6 | Create | -- |

**Suggested Learning Resources:**

**Text Books:**


1) Cloud Computing: A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, 1st Edition, The Orient Blackswan, 2014, ISBN: 9788173719233.
2) Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and S Thamarai Selvi, Tata McGraw Hill, New Delhi, India, 2013, ISBN: 9781259029950.
3) Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Kai Hwang, Jack Dungaree, and Geoffrey Fox, MK Publisher, 18 Dec 2013, ISBN: 9780128002049.


**Reference Books:**


1) Cloud Computing: Theory and Practice, Dan Marinescu, 3rd Edition, MK Publications, Elsevier 2022, ISBN: 9780323852777.
2) Cloud Computing: Master the Concepts, Architecture and Applications with Real-world Examples and Case Studies, Kamal Kant Hiran, 1st Edition, BPB Publications, 2019, ISBN: 9789388511407.
3) Cloud Computing, A Practical Approach, Anthony T. Volte,Toby J. Volte, Robert Elsenpeter, McGraw Hill, 2010, ISBN: 9780071626958.

| |
|---|
| **Web links and Video Lectures (e-Resources):**<br>• https://onlinecourses.nptel.ac.in/noc21_cs14/preview<br>• https://onlinecourses.nptel.ac.in/noc21_cs15/preview<br>• https://www.skytap.com/terms-glossary/virtual-lab-cloud/ |
| **Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning:**<br>• Demonstration of cloud platforms<br>• Video demonstration of Amazon web services<br>• Hands on session on creating an account in public cloud |

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## CYBER SECURITY AND CYBER LAW

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA242** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA242.1 | Discuss the various cybercrimes in a real time scenario. |
| 24MCA242.2 | Describe cybercrime specific to mobile and wireless devices. |
| 24MCA242.3 | Apply the appropriate tools and methods to address cyber security threats. |
| 24MCA242.4 | Analyze the cyber laws in Indian and global perspective. |
| 24MCA242.5 | Illustrate the usage of foreign tools and techniques for the investigation of cybercrimes. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA242.1 | - | - | - | - | - | - | - | - | 3 | - |
| 24MCA242.2 | - | 3 | 1 | - | - | - | - | - | 3 | - |
| 24MCA242.3 | - | 2 | - | 3 | - | - | - | - | 3 | - |
| 24MCA242.4 | - | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA242.5 | 3 | 2 | - | 3 | - | - | - | - | 3 | - |

| **MODULE-1** | **INTRODUCTION TO CYBERCRIME** | **24MCA242.1** | **8 Hours** |
|---|---|---|---|

Cybercrime-Introduction, Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, The Legal Perspectives of Cybercrimes: An Indian Perspective Cybercrime, Indian ITA 2000, and Global Perspective on Cybercrimes.
Cyber Offenses: Introduction, Criminals Planning the Attacks, Social Engineering, Cyber stalking, Cyber Cafe, Botnets- The Fuel for Cybercrime, Attack Vector, Cloud Computing.

| Text Book | Text Book 1: Chapter 2, Text Book 2: Chapter 1, 2 |
|---|---|

| **MODULE-2** | **CYBERCRIME MOBILE AND WIRELESS DEVICES** | **24MCA242.2** | **8 Hours** |
|---|---|---|---|

Introduction- Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Device Registry, Settings for Mobile Devices and Authentication Service.
Security Attacks on Mobile/Cell Phones, Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

| Text Book | Text Book 2: Chapter 3 |
|---|---|

| **MODULE-3** | **TOOLS AND METHODS USED IN CYBERCRIME** | **24MCA242.3** | **8 Hours** |
|---|---|---|---|

Introduction- Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.
Phishing and Identity Theft: Introduction to Phishing, types of Phishing, Identity Theft (ID Theft).

| Self-study / Case Study / Applications | Case study on Steganography |
|---|---|
| Text Book | Text Book 1: Chapter 6,8,9,10 Text Book 2: Chapter 4,5.1,5.2,5.3 |

| **MODULE-4** | **CYBERSECURITY LAWS** | **24MCA242.4** | **8 Hours** |
|---|---|---|---|

The Legal Perspectives -Introduction, Cybercrime and the Legal Landscape around the World, Need for Cyber laws, The Indian Context, The Indian IT Act, Challenges to Indian Law .Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students - Indian Scenario.

| Text Book | Text Book 2: Chapter 6 |
|---|---|

| **MODULE-5** | **COMPUTER FORENSICS** | **24MCA242.5** | **8 Hours** |
|---|---|---|---|

Understanding Computer Forensics -Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics

Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics.
Forensics and Social Networking Sites - The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti Forensics.

| | |
|---|---|
| Self-study / Case Study/ Applications | Hands on session on Digital Forensic and Anti forensic tools. |
| Text Book | Text Book 2: Chapter 7 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 5 | 5 |
| L2 | Understand | 10 | 5 | 5 |
| L3 | Apply | 5 | 2 | - |
| L4 | Analyze | 5 | 3 | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources**

**Text Books:**


1) Cyber Security and Cyber Laws-Alfred Basta, NadineBasta, MaryBrown, Ravinder Kumar, Cengage Publications, 2018, ISBN: 9789387511675.
2) Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives – Nina Godbole, Sunit Belapure, Wiley: 2011 India Publications Released, ISBN: 9788126521791.


**Reference Books:**


1) Cyber security fundamentals, Rajesh Kumar Goutam, BPB, 2021, ISBN: 9789390684731.
2) Internet Forensics: Using Digital Evidence to Solve Computer Crime- Robert Jones, O'Reilly Media, 2005, ISBN: 13-9780596100063.
3) Windows Forensics: The field guide for conducting corporate computer investigations - Chad Steel, Wiley, 2006 India Publications, ISBN: 13-9788126510368.


**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.swayam2.ac.in/cec20_cs15/preview
- https://sgp.fas.org/crs/misc/R43831.pdf
- https://www.youtube.com/watch?v=KTNfY0ve2QI

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Video demonstration on cybercrimes
- Case Study on latest tools for cyber security
- Hands-on Sessions on anti forensics tools

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## CRYPTOGRAPHY AND NETWORK SECURITY

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA243** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA243.1 | Discuss role of classical cryptographic techniques in the current scenario. |
| 24MCA243.2 | Summarize fundamental principles and applications of block ciphers |
| 24MCA243.3 | Apply methods for implementing and managing message authentication. |
| 24MCA243.4 | Identify common security policies and standards. |
| 24MCA243.5 | Evaluate the effectiveness of various security protocols for their impact network security. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA243.1 | 3 | - | - | - | - | - | - | - | 3 | - |
| 24MCA243.2 | 3 | - | - | - | - | - | - | - | 3 | - |
| 24MCA243.3 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA243.4 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA243.5 | 3 | - | 2 | - | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **CLASSICAL CRYPTOSYSTEM** | **24MCA243.1** | **8 Hours** |

Security Trends, Security Attacks and Services, Symmetric Cipher Model- Classical Encryption Techniques, LFSR sequences, Basic Number Theory, Congruence's, Chinese Remainder Theorem, Modular Exponentiation, Fermat and Euler's theorem, Legendre and Jacobi Symbols, Finite Field, Galois Field.

| | |
|---|---|
| Skill Development Activities | **HANDS ON:**<br>• The program implementation of Caesar cipher algorithm<br>• The program implementation of Transposition cipher algorithm |
| Text Book | Text Book 1 : Chapter 1, 2, 8 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **BLOCK CIPHER** | **24MCA243.2** | **8 Hours** |

Simple DES, DES, Modes of Operation – Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode. AES – Structure, Transformation functions, Key Expansion, Principles of Public-Key Cryptosystems. Triple DES, AES, RC4, RSA.

| | |
|---|---|
| Skill Development Activities | **HANDS ON:** Simple program implementation of DES algorithm |
| Text Book | Text Book 2 : Chapter 3, 9 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **MESSAGE AUTHENTICATION** | **24MCA243.3** | **8 Hours** |

Discrete Logarithms, Computing Discrete Logs, Diffie-Hellman Key Exchange, ElGamal Public Key Cryptosystems, Hash Functions, Secure Hash, Birthday Attacks, MD5, Digital Signatures, RSA, ElGamalm, DSA.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 12, 13 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **APPLICATION SECURITY** | **24MCA243.4** | **8 Hours** |

Kerberos, X.509, Public Key Infrastructure, Electronic Mail Security – Pretty Good Privacy, IP Security – Overview, Policy, Web Security – Threats, Traffic Security, Secure Socket Layer – Architecture, Record Protocol, Change Cipher Spec Protocol, Alert, Handshake Protocol.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 18, 19 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **WIRELESS NETWORK SECURITY** | **24MCA243.5** | **8 Hours** |

Wireless Network Security- IEEE 802.11 Wireless LANs - Protocol Overview and Security - Wireless Application Protocol (WAP) - Protocol Overview - Wireless Transport Layer Security (WTLS).

| | |
|---|---|
| Text Book | Text Book 1: Chapter 17 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 5 | 5 |
| L2 | Understand | 10 | 5 | 5 |
| L3 | Apply | 5 | 2 | - |
| L4 | Analyze | 5 | 3 | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources**

**Text Book:**


1) William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI, 8th edition, 2023, ISBN: 9781292437484.
2) Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 3rd ed, Pearson, 2020, ISBN: 9780135260166.


**Reference Books:**


1) W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007, ISBN: 0-13-066943-1.
2) Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in computing", Third Edition – Prentice Hall of India, 2006, ISBN: 978013408504-3.
3) Douglas R. Stinson. "Cryptography, theory and practice", September 2018 ,Second edition, CRS Press, ISBN: 9781138197015.


**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc22_cs90/preview
- https://onlinecourses.swayam2.ac.in/cec22_cs15/preview

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of working of classical encryption techniques
- Demonstration of RSA, DES algorithms
- Demonstration on Message Authentication methods like D-H key exchange, Digital signature
- Video demonstration of latest technology on web security

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## ARTIFICIAL INTELLIGENCE

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA244** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA244.1 | Discuss the foundations of artificial intelligence and problem-solving strategies. |
| 24MCA244.2 | Use logic structures with knowledge representation and engineering for intelligent agents. |
| 24MCA244.3 | Apply practical skills in handling uncertainty and making informed decisions in AI systems. |
| 24MCA244.4 | Analyze the role of planning and game playing in AI applications. |
| 24MCA244.5 | Discuss the integration of generative AI in business and technology. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA244.1 | 2 | - | - | - | - | - | - | - | 3 | - |
| 24MCA244.2 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA244.3 | 3 | 2 | - | - | - | - | - | - | 3 | - |
| 24MCA244.4 | 3 | 2 | 1 | - | - | - | - | - | 3 | - |
| 24MCA244.5 | 1 | - | 2 | - | - | - | - | - | 3 | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **INTRODUCTION AND SEARCH TECHNIQUES** | **24MCA244.1** | **8 Hours** |

Foundations of Artificial Intelligence (AI), Problem Solving Strategies, Problem Definition and Characteristics, Spaces and Search, Heuristic Search Technique–Generate and Test, Hill Climbing, Best First Search, Problem Reduction.

| | |
|---|---|
| Self-study / Case Study / Applications | Case studies on Search Techniques. |
| Text Book | Text Book 1: Chapter 1.1, 1.2, 2.1, 2.5, 3.1 to 3.4 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **KNOWLEDGE REPRESENTATION** | **24MCA244.2** | **8 Hours** |

Knowledge Representation using Predicate Logic, Use of Predicate Calculus, Knowledge Representation using other Logic Structured Representation of Knowledge, Knowledge-Based Agents, The Wumpus World as an Example; Propositional Logic – Reasoning Patterns, Agents, Syntax and Semantics of First – Order Logic, Its Usage, Knowledge Engineering.

| | |
|---|---|
| Text Book | Text Book 1: Chapter 4.1, 4.3, 4.5 to 4.7, 5.1 to 5.3 |

| | | | |
|---|---|---|---|
| **MODULE-3** | **KNOWLEDGE INFERENCE, REASONING AND DECISIONS** | **24MCA244.3** | **8 Hours** |

Quantifying Uncertainty- Acting Under Uncertainty, Basic Probability Notation, Inference, Independence, Baye's Rule; Probabilistic Reasoning – Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks with Exact and Approximate Inference; Making Decisions – Utility Theory and Functions, Decision Networks, Theoretic Expert Systems, Complex Decisions – Value, Policy Iterations.

| | |
|---|---|
| Text Book | Text Book 2: Chapter 13.1, to 13.5, 14.1, to 14.5, 16.3, 16.5, 17.1 to 17.3 |

| | | | |
|---|---|---|---|
| **MODULE-4** | **PLANNING AND GAME PLAYING** | **24MCA244.4** | **8 Hours** |

Basic Plan Generation Systems - Components of Planning System, Block World Planning System, Goal Stake Planning; Game Playing: The Mini-Max Search Procedure, Adding Alpha–Beta Cut-Offs Additional Refinements, Iterative Deepening and Reference on Specific Games.

| | |
|---|---|
| Self-study / Case Study / Applications | Case studies on Game playing strategies. |
| Text Book | Text Book 1: Chapter 3.5, 10.4 |

| MODULE-5 | GENERATIVE AI CONCEPTS AND TECHNIQUES | 24MCA244.5 | 8 Hours |
|---|---|---|---|

Generative AI – Introduction, Types of Generative AI, Business Ideas, Generative AI Model Building and Developing Process, Tools for Developing Generative AI Model, Generative AI – Practical Applications, Scope and Future Directions; How to Use Generative AI for Copyrighting, Graphic Design, Video Editing; Generative AI in Healthcare, Media and Education.

| | |
|---|---|
| Self-study / Case Study / Applications | Case studies on building Generative AI models. |
| Text Book | Text Book 3: Chapter 2, Chapter 3 |

**CIE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | MCQ's |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | 5 | 5 |
| L2 | Understand | 10 | 5 | 5 |
| L3 | Apply | 5 | 5 | - |
| L4 | Analyze | 5 | - | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Artificial Intelligence, Ela Kumar, Dreamtech Press, 2020, ISBN: 9789389795134.
2) Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education, 3rd Edition, 2015, ISBN: 9789332543515.
3) Artificial Intelligence & Generative AI for Beginners: The Complete Guide, David M. Patel, 2023, ISBN: 9798850705527.


**Reference Books:**


1) Artificial Intelligence, E. Rich, K. Knight & S.B. Nair, 3rd edition, McGraw-Hill, 2017, ISBN: 9780070087705.
2) Introduction to Artificial Intelligence and Expert Systems, Patterson, Pearson Education India, 2016, 9789332551947.
3) Generative AI in Practice: 100+ Amazing Ways Generative Artificial Intelligence is Changing Business and Society 1st Edition,2024, Wiley Publication, ISBN: 9781394245567.


**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/106102220
- https://nptel.ac.in/courses/106106140
- https://www.coursera.org/learn/introduction-to-generative-ai
- https://www.coursera.org/learn/introduction-to-ai

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Video demonstration on AI applications in real time scenario.
- Case Study on latest tools used for AI applications.
- Group Discussion on Generative AI Models.

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## SOFTWARE ENGINEERING AND TESTING

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA245** | **CIE Marks** | **50** |
| **L:T:P:S** | **3:0:0:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA245.1 | Explain the stages and importance of the Software Development Life Cycle. |
| 24MCA245.2 | Discuss the process of developing use cases and validating requirements for software design. |
| 24MCA245.3 | Apply Agile principles and practices to improve software quality and adapt to change. |
| 24MCA245.4 | Use the principles of software testing by developing test plans to effectively identify and resolve software defects. |
| 24MCA245.5 | Examine testing concepts through real-world case studies using open-source tools. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA245.1 | 2 | 3 | - | - | - | 2 | - | - | 2 | - |
| 24MCA245.2 | 2 | 3 | 3 | - | - | 2 | - | - | 2 | - |
| 24MCA245.3 | 2 | 3 | - | - | 3 | 2 | - | - | 2 | - |
| 24MCA245.4 | 2 | 3 | - | - | - | 2 | - | - | 2 | - |
| 24MCA245.5 | 2 | 3 | - | 3 | - | 2 | - | - | 2 | - |

| **MODULE-1** | **INTRODUCTION TO SOFTWARE ENGINEERING** | **24MCA245.1** | **8 Hours** |
|---|---|---|---|

The Nature of Software and Web Apps, Software Engineering, Software Process, Software Engineering Practices, Software Myths, Software Development Life Cycle. Process Models - A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, the Unified Process, Personal and Team Process Models, Process Technology, Product and Process.

| | |
|---|---|
| Text Book | Text Book 3: Chapter 1, 2 Text Book 3: Chapter 1, 2 |

| **MODULE-2** | **UNDERSTANDING REQUIREMENTS AND MAPPING TO DESIGN** | **24MCA245.2** | **8 Hours** |
|---|---|---|---|

Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements, Software Requirements Specification, and Case Study. Design Concepts - Design within the Context of Software Engineering, the Design Process, Design Concepts, and the Design Model Case Study for Design of any Application Project.

| | |
|---|---|
| Text Book | Text Book 4: Chapter 3, 5, 6 Text Book 1: Chapter 3 |

| **MODULE-3** | **AGILE DEVELOPMENT AND QUALITY CONCEPTS** | **24MCA245.3** | **8 Hours** |
|---|---|---|---|

Agility, Agile and the Cost of Change, Agile Process , Agility Principles, and Related Costs, Politics of Agile Development, Human Factors, Extreme Programming, Other Agile Process Models, Adaptive Software Development Scrum, DSDM, Crystal, FDD, LSD, Agile Modeling, Agile Unified Process - A Tool Set for the Agile Process – Case Study. Quality Concepts: Software Quality, Achieving Software Quality, Elements of Software Quality Assurance, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan.

| | |
|---|---|
| Text Book | Text Book 3: Chapter 12 Text Book 4: Chapter 1, 2 |

| **MODULE-4** | **INTRODUCTION TO SOFTWARE TESTING AND SOFTWARE AUTOMATION** | **24MCA245.4** | **8 Hours** |
|---|---|---|---|

Fundamentals of Testing, Testing Objectives, Software Testing Life Cycle (STLC), Test Planning, Manual Testing Formats. Software Automation: Fundamentals of Test Automation, Design and Architecture for Automation, Challenges in Automation.

| | |
|---|---|
| Self-study / Case Study / Applications | **HANDS ON:**<br>• Designing and Recording test cases and test suites using Selenium IDE.<br>• Installation of Selenium Web Driver.<br>• Automation program to login into a webpage. |
| Text Book | Text Book 1: Chapter 9, Text Book 3: Chapter 3, Text Book 4: Chapter 1, 2, 3 |

| **MODULE-5** | **SELENIUM IDE AND SELENIUM WEB DRIVER** | **24MCA245.5** | **8 Hours** |
|---|---|---|---|

Selenium IDE Installation, Recording and Running Test Cases using Selenium IDE, Selenium Commands.

Selenium Web Driver: Introduction to Web Driver, Architecture, Installation of Selenium Web Driver, Case Study – Apply testing concepts using Open Source tools.

| | |
|---|---|
| Self-study / Case Study / Applications | **HANDS ON:**<br>• An automation program to test whether a test case has passed or failed.<br>• A program to read the contents of an excel file and printing the contents on the selenium output console using jxl.<br>• Program to count the total number of hyperlink objects present on a webpage. |
| Text Book | Text Book 2: Chapter 1, 2, 3 |

**CIE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Assessment | MCQs |
| | | 25 | 15 | 10 |
| L1 | Remember | 5 | - | - |
| L2 | Understand | 10 | - | 5 |
| L3 | Apply | 5 | 5 | 5 |
| L4 | Analyze | 5 | 10 | - |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern(50 Marks – Theory)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 20 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Sharma, Pallavi. Selenium with Java - A Beginner's Guide: Web Browser Automation for Testing Using Selenium with Java. India, BPB Publications, 2022, ISBN: 13-9789355511914.
2) Baumgartner, Manfred, et al. Test Automation Fundamentals: A Study Guide for the Certified Test Automation Engineer Exam – Advanced Level Specialist – ISTQB® Compliant. Germany, Punkt. verlag, 2022, ISBN: 13-978-3969103181.
3) Hitesh, Mohapatra Prof. Amiya Kumar. Fundamentals of Software Engineering. India, BPB Publications, 2020, ISBN-13: 978-9389845774.
4) Merkow, Mark. Secure, Resilient, and Agile Software Development. United States, CRC Press, 2019, ISBN-13: 978-1138333031.


**Reference Books:**


1) Stephens, Rod. Beginning Software Engineering. United States, Wiley, 2022.
2) Bierig, Ralf, et al. Essentials of Software Testing. Singapore, Cambridge University Press, 2021.


**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc22_cs61/preview
- https://archive.nptel.ac.in/courses/106/101/106101163/
- https://www.coursera.org/specializations/software-testing-automation
- https://www.geeksforgeeks.org/software-engineering/
- https://www.selenium.dev/selenium-ide/docs/en/introduction/getting-started
- https://github.com/SeleniumHQ/selenium-ide

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Student Seminar Presentations
- Automated Testing of a web application Using Selenium IDE

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## LAB BASED PROFESSIONAL ELECTIVES – 1
## BUSINESS INTELLIGENCE AND DATA ANALYTICS

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA251** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:1:2:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA251.1 | Discuss the fundamentals of Tableau and data visualization principles |
| 24MCA251.2 | Apply data connection and transformation techniques in Tableau |
| 24MCA251.3 | Examine and enhance interactive dashboards and stories |
| 24MCA251.4 | Analyze and synthesize data using advanced calculations and analytics in Tableau. |
| 24MCA251.5 | Evaluate complex data models in Tableau using data blending, forecasting, and predictive analytics. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA251.1 | 1 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA251.2 | 3 | 1 | - | - | - | - | - | - | 2 | 1 |
| 24MCA251.3 | 3 | 3 | 3 | - | - | - | - | - | 2 | 1 |
| 24MCA251.4 | 3 | 3 | 3 | 1 | - | - | - | - | 2 | 1 |
| 24MCA251.5 | 3 | 3 | 2 | 2 | - | - | - | - | 2 | 1 |

| | | | |
|---|---|---|---|
| **MODULE-1** | **INTRODUCTION TO TABLEAU AND DATA VISUALIZATION** | **24MCA251.1** | **3 Hours** |

Connections to Data, Foundations for Building Visualizations, Visualizing Data, Creating Charts, Creating Geographic Visualizations. Working With Data - Connecting to Data, Managing Data Source Metadata, Working with Extracts Instead of Live Connections, File Types, Joins and Blends, Filtering Data.

**Laboratory Component:** **6 Hours**

1. *Write the procedure to get started with Tableau Interface and Connecting to Data.*
2. *Write the procedure to create a bar chart to visualize the total sales by product category and interpret the results for Superstore Dataset.*
3. *Write the procedure to create a line chart to visualize sales trends over time and interpret the results for Superstore Dataset.*
4. *Write the procedure to visualize the distribution of sales across different regions using a pie chart and interpret the results for Superstore Dataset.*
5. *Write a procedure to create a filled map to visualize sales by state and interpret the results.*
6. *Write a procedure to combine hospital visit data with Hospital Goals data source and demonstrate various types of joins.*

*(Note: Use Superstore Dataset)*

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1, 2, 3 Text Book 2: Chapter 1, 2 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **DATA CONNECTIONS AND TRANSFORMATION** | **24MCA251.2** | **3 Hours** |

Comparing Values Across Different Dimensions, Visualizing Dates, and Times, Relating Parts of the Data to the Whole, Visualizing Distributions, Visualizing Multiple Axes to Compare Different Measures, using Row-Level, Aggregate Level, and Level of Detail Calculations.

**Laboratory Component:** **6 Hours**

1. *Compare the performance and usability of live vs. extract data connections.*
2. *Filter the data to show visits within a specific date range and sort the visits by department or physician. Visualize the top 5 departments with the highest number of visits.*

3. *Create a calculated field to determine the average length of stay per visit. Use this field in a visualization to compare the average length of stay across different departments or patient age groups.*
4. *Create a time series visualization showing the number of visits by month, quarter, or year. Use the visualization to identify any seasonal patterns or trends in hospital visits.*
5. *Write the procedure to perform the following row-level calculations from the Hospital Visit Dataset.*
   a) *Create a row-level calculation to determine the number of days each patient stayed in the hospital.*
   b) *Develop a row-level calculation to determine the average cost per day for each patient's stay.*
   c) *Implement a row-level calculation to identify if a patient was readmitted within 30 days of discharge.*
   d) *Establish a row-level calculation to determine the age of each patient at the time of admission.*
6. *Write the procedure to perform the following row-level calculations from the Hospital Visit Dataset.*
   a) *Create a row-level calculation to determine the total revenue generated by each rental based on nightly rate and number of nights booked.*
   b) *Develop a row-level calculation to determine the occupancy rate for each rental by comparing the number of nights booked to the total available nights.*
   c) *Implement a row-level calculation to calculate the cleaning fee per night by dividing the total cleaning fee by the number of nights booked.*
   d) *Establish a row-level calculation to determine the number of days since the last review was submitted for each rental, based on the current date and the date of the last review.*

| Text Book | Text Book 1: Chapter 4, 5 | | |
|---|---|---|---|
| **MODULE-3** | **DEVELOPING DASHBOARDS AND STORIES** | **24MCA251.3** | **3 Hours** |

Creating and Editing Table Calculations, Quick Table Calculations, Relative Versus Fixed Scope and Direction, Addressing and Partitioning, Custom Table Calculations, Practical Examples, Data Densification.

**Laboratory Component:** **6 Hours**

1. *Write a procedure to create a table calculation to compute the running total of sales over time. Edit the calculation to show the running total by different categories (e.g., by Region or Product Category).*
2. *Write a procedure to apply a quick table calculation to calculate the year-over-year growth in profit. Visualize the growth trends across different segments (e.g., Customer Segment or Product Sub-Category).*
3. *Write a procedure to create a calculation to compute the percent difference in sales from the first to the last month. Experiment with relative and fixed scope settings to observe how the calculation changes when applied to different levels (e.g., Region, Year).*
4. *Write a procedure to build a table calculation to compute the rank of sales within each Region. Adjust the addressing and partitioning options to rank the sales either across the entire dataset or within each Region.*
5. *Write a procedure to design a custom table calculation to calculate the cumulative profit margin across months. Use calculated fields to customize the formula and display the results in a line chart.*
6. *Write a procedure to implement data densification techniques to fill in missing data points for a time series analysis of sales by month. Ensure that the visualization shows a continuous trend line, even if some months have no recorded sales data.*

| Text Book | Text Book 1: Chapter 6, 7 | | |
|---|---|---|---|
| **MODULE-4** | **ADVANCED CALCULATIONS AND ANALYTICS** | **24MCA251.4** | **3 Hours** |

Formatting, Adding Value to Visualizations. Data Story with Dashboards: Building Views, Creating the Dashboard Framework, Implementing Actions, and Designing Different Displays and Devices.
Deep Analysis - Trending, Clustering, Distributions, Forecasting.

**Laboratory Component:** **6 Hours**

1. *Write a procedure to design a dashboard in Tableau for Superstore Dataset.*
   a) *To format a sales dashboard to enhance readability and aesthetic appeal.*
   b) *To apply consistent font styles, adjust color schemes to align with data significance, and add gridlines and borders where necessary.*
   c) *To include formatted tooltips that provide additional context.*
2. *Write a procedure to*

a) *To enhance a profit margin visualization by adding reference lines for target margins, using color coding to highlight outliers, and incorporating annotations to explain key insights.*
b) *To add a parameter that allows users to switch between different metrics, such as profit and discount.*

3. *Write a procedure to create multiple views to analyze sales performance by region, category, and customer segment. Ensure each view highlights a specific aspect of the data, such as top-performing regions or categories with declining sales.*
4. *Write a procedure to design a dashboard framework in Tableau for Superstore Dataset.*
   a) *That integrates the views created in the previous task*
   b) *To organize the layout to ensure a logical flow of information, making use of containers, titles, and legends to structure the dashboard effectively.*
5. *Write a procedure to design a Data Story with Dashboards for Super store Dataset.*
   a) *To implement Actions and Designing for Different Displays.*
   b) *Add interactive actions to the dashboard, such as filter actions to allow users to drill down into specific regions or product categories, and highlight actions to emphasize selected data points.*
   c) *Design and test the dashboard for different display sizes and devices, ensuring a responsive layout.*
6. *Write a procedure to create the following in Tableau using Superstore Dataset.*
   a) *To perform a deep analysis by creating a trend line to forecast future sales.*
   b) *To apply clustering to identify distinct customer segments based on purchasing behavior, and visualize sales distribution across regions.*
   c) *To use Tableau's built-in forecasting and clustering tools to derive insights and present these in a comprehensive analysis dashboard.*

| | |
|---|---|
| Self-study / Case Study / Applications | Building advanced chart types for deeper insights analyzing complex data sets and synthesizing insights for a health organization |
| Text Book | Text Book 1: Chapter 7, 8, 9 |

| **MODULE-5** | **DATA BLENDING, FORECASTING AND PREDICTIVE ANALYTICS** | **24MCA251.5** | **3 Hours** |
|---|---|---|---|

Structuring Data, Techniques for Dealing with Data Structure Issues, Advanced Visualizations, Advanced Mapping Techniques, using Background Images, Sharing Data Story Through Presentations, Printing, Exporting and Publishing.

**Laboratory Component:** **6 Hours**

1. *Write a procedure to identify and correct inconsistencies in the Superstore dataset, such as fixing incorrect date formats and ensuring that sales figures are correctly categorized.*
2. *Write a procedure to clean the dataset by removing duplicates and filling in any missing values. Use filters to exclude irrelevant data from your analysis.*
3. *Write a procedure to create the following advanced visualizations in Tableau*
   a) *A dual-axis chart to compare sales and profit trends,*
   b) *A butterfly chart to compare customer segments.*
   c) *A Pareto chart to highlight the top 20% of products contributing to 80% of sales*
4. *Write a procedure to perform the following visualizations for superstore dataset*
   a) *To create a complex map visualization that shows sales performance across different geographic regions.*
   b) *To use advanced mapping techniques such as custom territories, map layers, and data density heat maps.*
   c) *To integrate additional geographical data, like population density, to provide context to sales figures.*
5. *Write a procedure to design a custom visualization using a background image. For example, use a floor plan of a fictional Superstore and place visual markers on the image to show the location-based performance of different departments. Overlay sales or profit data on specific sections of the store to visualize spatial*

*performance.*

6. *Create a comprehensive data story by developing a Tableau Story with multiple dashboards and narrative captions. Export the story as a PDF for offline use, print selected views for inclusion in a report, and publish the workbook to Tableau Public or Tableau Server.*

| | |
|---|---|
| Self-study / Case Study / Applications | Evaluating and creating complex data models and analyses and designing and presenting a comprehensive business intelligence solution using advanced Tableau features for a retail company. |
| Text Book | Text Book 1: Chapter 13, 14, 15 |

**CIE Assessment Pattern (50 Marks – Hands On)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 5 | 5 | 4 |
| L3 | Apply | 10 | 10 | 4 |
| L4 | Analyze | 10 | - | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Practical)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 5 |
| L3 | Apply | 20 |
| L4 | Analyze | 20 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**

1) Learning Tableau 10, Business Intelligence and data visualization that brings your business into focus, By Joshua N. Milligan, 2016, Packt Publishing, Second edition. ISBN: 13-9781789534221.
2) Laursen, G.H. and Thorlund, J., 2016. Business analytics for managers: Taking business intelligence beyond reporting. John Wiley & Sons, ISBN: 9781119295850.

**Reference Books:**

1) Business Intelligence Guidebook: From Data Integration to Analytics 1st Edition, by Rick Sherman, 2014, Morgan Kaufmann Publisher, ISBN: 13-9780124114616.

**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/110107092
- https://www.tableau.com/products/desktop

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Brainstorming on the choice of appropriate techniques for various real-time scenarios.
- Creating a comprehensive World Happiness Report Dataset Analysis

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## MOBILE APPLICATION DEVELOPMENT

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA252** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:1:2:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA252.1 | Discuss basic programming concepts and principals to develop Android applications |
| 24MCA252.2 | Apply common design patterns used in mobile app interfaces |
| 24MCA252.3 | Use the techniques for inter-process communication. |
| 24MCA252.4 | Analyze aspects of data storage and communication integration in mobile app |
| 24MCA252.5 | Examine strategies for deploying Android application. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA252.1 | 3 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA252.2 | 3 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA252.3 | 3 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA252.4 | 3 | 2 | - | - | - | - | - | - | 2 | 1 |
| 24MCA252.5 | 3 | 2 | 3 | 1 | - | - | - | - | 2 | 1 |

| **MODULE-1** | **INTRODUCTION TO ANDROID** | **24MCA252.1** | **3 Hours** |
|---|---|---|---|

Android Architecture, Android Development Framework-Android SDK, Project Framework, User Interface, Gradle Build System, Debug and Profile Tools, Android Emulator, AVD in Android Studio, Hardware Device, Basic Building Blocks – Activities, Services, Broadcast Receivers and Content Providers, UI Components-Views and Notifications, Components for Communication -Intents and Intent Filters.

**Laboratory Component:** **6 Hours**

1. *Using Android SDK display Hello world in Android Studio.*
2. *Develop an Android application using explicit intent to display the login page. On giving the wrong credentials, it should display the toast message and if credentials are correct, it should display Welcome and the username.*
3. *Develop an Android application to design a Visiting card. The visiting card should have a company logo at the top right corner. The company name should be displayed in capital letters, aligned to the center. Information like Name of the employee, Designation, Phone number, Address, Email, and the Website address is to be displayed.*
4. *Design and implement a single screen app that displays information about a small business. eg. Restaurant, Bookshop etc. Your design must include:*
    a. *Business name*
    b. *Photo of business*
    c. *Contact information*
5. *Design and develop a Mobile App for smart phones-Unit Converter using Android Studio.*
6. *Design and develop a Mobile App for smart phones-Currency Converter.*

| | |
|---|---|
| Self-study / Case Study / Applications | • Case Study on Android dominates global market; iOS excels in user experience niche.<br>• Case Study on Android's Evolution, Market Dominance, and Development Challenges. |
| Text Book | Text Book 1: Chapter 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 |

| **MODULE-2** | **APPLICATION STRUCTURE AND BASIC UI DESIGN** | **24MCA252.2** | **3 Hours** |
|---|---|---|---|

Activity Lifecycle, Draw Able Resources, View Groups, Layouts – Linear Layout, Frame Layout, GridView Using Basic View- Text View, Button, Edit Text Box, Checkbox and Radio Button, Screen Orientation, Event Handling for Views, Recycler View, Adapter and View Holder, Alert Dialog, Date Picker, Time Picker.

**Laboratory Component:** **6 Hours**

1. *Design and develop a Mobile App that displays "Welcome to Android Application" in a TextView, accept name of student in EditView, on Button click concatenate welcome message with Name as "Welcome to Android Application" + name of student.*
2. *Design and develop a Mobile App that displays Alert Dialog control with appropriate buttons, when activity is onStart() display "By Clicking Ok you Accept T&C Click Cancel to quit Application", onDestroy() it must display "Do you really want to close this application ?".*
3. *Develop an Android application using Button, TextView and EditText for designing a Calculator having basic functionality like Addition, Subtraction, Multiplication and Division.*
4. *Design an app for Tourist spot with the following three activities: Welcome page, display highlights of tourist spot and webpage of the tourist spot.*
5. *Design and develop a Mobile App that displays Messages based on Screen Orientation, when project is loaded it should display "You are in Portrait mode – Background color is green", and when screen is rotated it must display "You' re in Landscape mode – Background color is Red".*
6. *Design and develop a Mobile App That displays 2 labels as "Date of Birth", "Time of Birth" and 2 buttons as "Pick a Date of Birth" and "Pick Time of Birth" when button is clicked it should show DatePicker and TimePicker Dialog controls, and value selected must be set to respective labels.*

| | |
|---|---|
| Self-study / Case Study / Applications | • *Case Study on Optimizing Application Structure and User Interface Design Principles*<br>• *Case Study on Efficient Android app structure with MVVM architecture; intuitive UI design using Material Design for responsive, accessible user experience."* |
| Text Book | Text Book 1: Chapter 7.1, 7.2, 7.3, 7.6, 7.7 |

| **MODULE-3** | **WORKING WITH MULTIMEDIA AND INTERACTIVE MEDIA DEVELOPMENT** | **24MCA252.3** | **3 Hours** |
|---|---|---|---|

Working with Images using - Image View, Gallery View, Grid View, Image Switcher View, Displaying Context Menu for Image View, Using Built-in Clock and Embedding Web Browser- Analog Clock, Digital Clock, Web View Notifications - Creating Notification using - Toast, StatusBar, Dialog Graphics - Drawing Graphics on Canvas – using View Class & Surface View Class, using Drawable Object – Referencing an Image File, Defining Drawable in xml, Shape Drawable Object, Nine Patch Drawable Graphics, Animations - Property Animation, View Animation, Drawable Animation Media Player - Using Media Player – Media Formats Supported by Media Player, Playing Audio and Video, Creating Application to Play Audio and Video Recording and Playing Sound - Use of Media Store, Creating Sound Pool Working with Camera - Using Camera for Taking Pictures, Recording Video, Create Video Recording Application.

**Laboratory Component:** **6 Hours**

1. *Design and develop a Mobile Appthat displays audio files stored in raw folder in a ListView, default audio file in a TextView, and Three buttons that displays "Play", "Pause", and "Stop". When audio file selected in ListView that must be displayed in TextView for playing.*
2. *Design and develop a Mobile Appthat displays button as "I am Long Toast appears at default position", "I am a Short Toast, I will stay for 2 sec(approximately)!", "I am Short Toast appears at margin 50,50 positions"*
3. *Design and develop a Mobile App That displays subjects of 2 Semesters using menu, and context menu. When menu button is clicked it must display subject titles and selected it must display toast.*
4. *Create an Android Application Project that displays images in a GridView, when image is selected it must show enlarged image inImageView.*
5. *Create an Android Application Project that displays Analog and Digital Clock, and ListView with color names, when selected color in the ListView, background color of clock must be changed.*
6. *Create an Android Application Project that displays an image using ImageView and rotates using View Animation*

| | |
|---|---|
| Text Book | Text Book 1: Chapter 9.1 to 9.6 |

| **MODULE-4** | **STORING DATA PERSISTENTLY, CONTENT PROVIDERS, EMAILING, TELEPHONY, SMS** | **24MCA252.4** | **3 Hours** |
|---|---|---|---|

Using Preferences - Shared Preferences Object using Internal Storage - Exploring Methods used for Internal Storage, Save Data to File using External Storage - Exploring Methods used for External Storage, Save Data to File SQLite Database - DataBase Helper Class, Performing insert, update, delete, search operation on Database Content Providers - Exploring Android, Provider Package, Creating and Consuming User-Defined Content Provider Emailing - Sending Mail Telephony- Application – To Display Phone Information, Receiving Phone

Calls, Making Phone Calls SMS - Sending SMS – using SmsManager, Receving SMS – using Broadcast Receiver, Role of Default SMS providers.

**Laboratory Component:** **6 Hours**

1. *Create an Android Application Project that records audio which display "Start Recording", "Stop Recording", "Play Recording" in 3 buttons when clicked appropriate button it must perform that action.*
2. *Create an Android Application Project that records video using camera that has SurfaceView and 2 buttons those records and stop when clicked.*
3. *Design Android app "Play Music" in the background.*
4. *Design and develop a Mobile App "The Expense Manager"for smart phones using Android. The app should store all the expenses in a file.*
5. *Design and develop Health Monitoring App using Android. The app will store the blood pressure, blood group and glucose level of a patient in SQLite database.*
6. *Develop an Android app to alert SMS to one given phone number.*

| Text Book | Text Book 1: Chapter 15.1, 15.2 |
|---|---|

| **MODULE-5** | **ADVANCED ANDROID APP DEPLOYMENT** | **24MCA252.5** | **3 Hours** |
|---|---|---|---|

Widgets - Home Screen widgets, Collection View Widgets Live Wallpaper Threads - Introducing Threads, Worker Threads, AsyncTask Services - Introducing Services, Exploring Services Essentials, Lifecycle of Service, Exploring & Introducing Service Class Apps with Location-Based Services and Google Maps, Building App with Camera, Preparing for Publishing – Signing & Versioning of Apps, Using Google Play to Distribute & Monetize, Best Practices for Security and Privacy.

**Laboratory Component:** **6 Hours**

1. *Design and develop a Mobile App that displays 4 TextView that accepts book details like filename, Author name, title, price of book, when clicked save button it stores in a file.*
2. *Design and develop a Mobile App that display 3 TextView that accept employee details like emp id, emp name, salary, when save is clicked it stores in database, and when update or delete is clicked appropriate records will be updated or deleted*
3. *Design and develop a Mobile App that displays a 2 EditView that accepts mobile number and message to be send using SmsManager.*
4. *Design and develop a Mobile App that displays 5 EditView which accepts mail-id, cc, bcc, subject and message to be send using built-in email application through intent object*
5. *Design and develop a Mobile App That displays TextView and a button, by default it must have urlhttp://www.nhce.edu.in/ when button is clicked it must load that website in built-in web browser using intent.*
6. *Develop an Android application to display Map of your college locality.*

| Text Book | Text Book 2: Chapter 5.1 to 5.10 |
|---|---|

**CIE Assessment Pattern (50 Marks – Hands On)**

| **RBT Levels** | | **Marks Distribution** | | |
|---|---|---|---|---|
| | | **Test (s)** | **Qualitative Assessment (s)** | **Weekly Assessment** |
| | | **25** | **15** | **10** |
| **L1** | **Remember** | - | - | - |
| **L2** | **Understand** | 5 | 5 | 4 |
| **L3** | **Apply** | 10 | 10 | 4 |
| **L4** | **Analyze** | 10 | - | 2 |
| **L5** | **Evaluate** | - | - | - |
| **L6** | **Create** | - | - | - |

**SEE Assessment Pattern (50 Marks – Practical)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| **L1** | **Remember** | **5** |
| **L2** | **Understand** | **5** |
| **L3** | **Apply** | **20** |
| **L4** | **Analyze** | **20** |
| **L5** | **Evaluate** | **-** |
| **L6** | **Create** | **-** |

**Suggested Learning Resources:**

**Text Books:**

1. Learn Android Studio 4, Efficient Java-Based Android Apps Development, Ted Hagos, Apress, 2020, ISBN: 9781484259368.
2. Mastering Android Studio: A Beginner's Guide, Sufyan bin Uzayr, Taylor & Francis Ltd; 1st edition, 2022, ISBN: 9781032134123.

**Reference Books:**

1. Professional Android4 Application Development, RetoMeier, Wrox, 2012.
2. Beginning iOS6 Development: Exploring the iOSSDK, DavidMark, Jack Nutting, Jeff La Mouche, and Fredric Olsson, Apress, 2013.
3. Android in Practice, Charlie Collins, Michael Galpin and Matthias Kappler, DreamTech, 2012.

**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.swayam2.ac.in/nou24_ge66/preview
- https://developer.android.com/develop

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Case Study: Development of "Duolingo" - A Language Learning Mobile Application
- Group Study on the development of Airbnb's mobile app that facilitated peer-to-peer lodging rentals, creating a new category in the travel industry

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## COMPETITIVE PROGRAMMING WITH PYTHON

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA253** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:1:2:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA253.1 | Demonstrate proficiency in Python basics, including data types, collections, and operators, to solve simple computational problems. |
| 24MCA253.2 | Apply control structures, and user-defined functions to design efficient algorithms. |
| 24MCA253.3 | Use Python libraries for data manipulation, processing, and analysis. |
| 24MCA253.4 | Identify statistical models and perform exploration data analysis using Python for meaningful insights from datasets. |
| 24MCA253.5 | Derive data visualizations using advanced plotting techniques and implement interactive features for better data representation. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA253.1 | 1 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA253.2 | 3 | 1 | - | - | - | - | - | - | 2 | 1 |
| 24MCA253.3 | 3 | 3 | 3 | - | - | - | - | - | 2 | 1 |
| 24MCA253.4 | 3 | 3 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 1 |
| 24MCA253.5 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 |

| | | | |
|---|---|---|---|
| **MODULE-1** | **PYTHON BASICS** | **24MCA253.1** | **3 Hours** |

Introduction to Python,, Comments, Variables, Datatypes, Type Casting, Operators, Exploring various Python IDE Tools, Collection Data Types-Strings, Lists, Tuple, Set, Dictionaries.

**Laboratory Component:** **6 Hours**

1. *Write a program to implement a Simple Calculator Using Operators*
2. *Write a python program to implement indexing, slicing, find, format and join in Strings.*
3. *Write a python program to remove duplicate elements from a list.*
4. *Write a program to sort a list and merge two lists.*
5. *Write a program to validate user login information using a dictionary.*
6. *Write a program to perform set operations.*

| | |
|---|---|
| Text Book | Text Book 1: 1.2-1.7 ,2.2, 2.3, 3.1-3.5, 8.1-8.5, 9.1-9.3, 10.1-10.3 |

| | | | |
|---|---|---|---|
| **MODULE-2** | **CONTROL STATEMENTS AND FUNCTIONS** | **24MCA253.2** | **3 Hours** |

Conditional Statements, Looping Statements, Loop Control Statements, Functions-math, random, user defined functions, function parameters, variable arguments, lambda functions

**Laboratory Component:** **6 Hours**

1. *Write a program to determine the grade and eligibility for scholarship based on marks.*
2. *Write a program for Random Password Generator Using random module.*
3. *Write a function that calculates the total price with optional discount to implement Variable Arguments and Keyword Arguments.*
4. *Write a lambda-based calculator.*
5. *Write a program to generate prime numbers in a range using looping and conditional statements.*
6. *Write user-defined functions to create a simple bank account system for depositing, withdrawing, and checking balance.*

| | |
|---|---|
| Text Book | Text Book 1: 4.2-4.7, 5.1-5.4 |

| MODULE-3 | PYTHON LIBRARIES | 24MCA253.3 | 3 Hours |
|---|---|---|---|
| Numpy - NumPy arrays, advanced array operations, working with random numbers, data processing Pandas-Data Manipulation, Data Cleaning, Data Transformation, Scikit, SciPy-SciPy vs NumPy, Constants and Special Functions, Optimization. | | | |
| **Laboratory Component:** **6 Hours**<br>1. *Write a program to create a 3D array and reshape it into different dimensions. Perform matrix addition, subtraction, multiplication, and transpose using NumPy.*<br>2. *Write a program to create a Data Frame, add/remove columns, and perform basic filtering.*<br>3. *Write a program to perform data imputation for missing values.*<br>4. *Write a program to group data into clusters.*<br>5. *Write a program to solve a system of linear equations using SciPy.*<br>6. *Write a program to fit a quadratic curve to a given dataset using scipy.optimize.curve_fit* | | | |
| Text Book | Text Book 2: 1.3 | | |
| **MODULE-4** | **PYTHON FOR STATISTICAL MODELS** | **24MCA253.4** | **3 Hours** |
| Exploratory Data Analysis-Identifying trends, patterns, and outliers in datasets, Regression Analysis-Linear Regression, Logistic Regression, Descriptive Statistics-Mean, Median, Mode. Variance, Standard Deviation Correlation | | | |
| **Laboratory Component:** **6 Hours**<br>1. *Write a program to predict values using linear regression.*<br>2. *Write a program to calculate mean, median, variance, and standard deviation for a dataset.*<br>3. *Write a program to classify whether a student passes or fails based on their study hours. Using logistic regression*<br>4. *Write a program to forecast time series data using the ARIMA model.*<br>5. *Write a program to compute the Pearson correlation coefficient.*<br>6. *Write a program to perform a chi-square test for independence.* | | | |
| Self-study / Case Study / Applications | *To analyze employee data and predict the likelihood of attrition using a statistical model. The IBM HR Analytics Employee Attrition Dataset, available on Kaggle, is used.* | | |
| Text Book | Text Book 4: 5.2, Text Book 5: 3.6, 4.7 | | |
| **MODULE-5** | **PYTHON FOR DATA VISUALISATION** | **24MCA253.5** | **3 Hours** |
| Line Chart, Bar Chart, Scatter Plot, Histogram, Pie Chart, Box Plot, Violin Plot,3D Scatter Plot, Implementing Interactive Features to the plots. | | | |
| **Laboratory Component:** **6 Hours**<br>1. *Write a program to visualize data using a bar chart, line chart and pie chart.*<br>2. *Write a program to create a box plot to show the distribution of a dataset and identify outliers.*<br>3. *Write a program to create a heatmap and pairplot using seaborn to visualize correlations in a dataset.*<br>4. *Write a program to create a 3D plot to visualize data in three dimensions.*<br>5. *Write a program to create an interactive scatter plot and line plot using Plotly.*<br>6. *Write a program to create an animated plot to visualize how data evolves over time.* | | | |
| Self-study / Case Study / Applications | *Data visualization to analyze and represent COVID-19 trends globally and regionally. The focus is on understanding patterns in infection rates, recoveries, and fatalities using interactive and static plots. Johns Hopkins University COVID-19 Data Repository (available on GitHub) can be used.* | | |
| Text Book | Text Book 3: 4,5,7 | | |

**CIE Assessment Pattern (50 Marks – Hands On)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 5 | 5 | 4 |
| L3 | Apply | 10 | 10 | 4 |
| L4 | Analyze | 10 | - | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Practical)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | - |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | 10 |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Gowrishankar, S., & Veena, A. (2018). *Introduction to Python Programming*. Chapman and Hall/CRC. ISBN: 9781351013215
2) Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython Author: Wes McKinney, 3rd Edition, O'Reilly Media, 2022, ISBN: 9781098104030.
3) Milovanović, I., Foures, D., & Vettigli, G. (2016). *Python Data Visualization Cookbook* (2nd ed.). Packt Publishing. ISBN: 9781787126749.
4) Python Data Science Handbook: Essential Tools for Working with Data by Jake VanderPlas, 1st Edition, O'Reilly Media, 2016, ISBN: 9781491912058.
5) James, G., Witten, D., Hastie, T., Tibshirani, R., & Taylor, J. (2023). *An Introduction to Statistical Learning: with Applications in Python* (1st ed.). Springer. ISBN: 9783031387463.


**Reference Books:**


1. Competitive Programming in Python: 128 Algorithms to Develop Your Coding Skills by Christoph Dürr and Jill-Jenn Vie, 1st Edition, Cambridge University Press, 2020, ISBN: 9781108716826.
2. Introduction to Computation and Programming Using Python by John V. Guttag, 3rd Edition, MIT Press, 2021, ISBN: 9780262542364.
3. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinney, 3rd Edition, O'Reilly Media, 2022, ISBN: 9781098104030.


**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc21_cs32/preview
- https://onlinecourses.nptel.ac.in/noc22_cs32/
- https://www.learnpython.org/

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Simulate and visualize a dice roll or card deck operations using Numpy
- Analyze a real-world dataset like COVID-19 stats or e-commerce sales using Pandas.

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## NON RELATIONAL DATABASES (NoSQL ) WITH MongoDB

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA254** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:1:2:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA254.1 | Discuss the key features of NoSQL databases and representation of data in MongoDB. |
| 24MCA254.2 | Illustrate the use of data definition and data manipulation commands in MongoDB. |
| 24MCA254.3 | Use queries with operators and expressions to retrieve specific data from the documents. |
| 24MCA254.4 | Identify the best indexing strategy for query optimization. |
| 24MCA254.5 | Examine the aggregation framework and MapReduce operations for complex data processing. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA254.1 | 2 | - | - | 1 | - | - | - | - | 2 | 1 |
| 24MCA254.2 | 3 | - | 2 | 1 | - | - | - | - | 2 | 1 |
| 24MCA254.3 | 3 | - | 2 | 1 | - | - | - | - | 2 | 1 |
| 24MCA254.4 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | 1 |
| 24MCA254.5 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | 1 |

**MODULE-1** **INTRODUCTION TO NOSQL AND MONGODB** **24MCA254.1** **3 Hours**

The Need for NOSQL, Difference Between SQL and NOSQL, ACID vs. BASE, Advantages and Disadvantages of NOSQL Databases, Types of NOSQL Databases- Key-Value Pair Database, Document Databases, Column Family Databases, Graph Databases.

MONGODB - Documents, Collections, Dynamic Schemas, Naming, Databases, Introduction to the MongoDB Shell, Running the Shell, MongoDB Client, Basic Operations with the Shell, Basic Data Types, Dates, Arrays, Embedded Documents_Id and Object_Id.

**Laboratory Component:** **6 Hours**

1. *Write a program to start, connect to MongoDB server and explore the shell environment.*
2. *Write a program to demonstrate the fundamental operations and interactions with the MongoDB database.*
3. *Write a program to demonstrate the following operations using the MongoDB shell:*
   - i. *Creating a new database*
   - ii. *Displaying the list of databases*
   - iii. *Checking the current database*
   - iv. *Switching to a different database*
4. *Write a program to demonstrate the create and insert operations in MongoDB:*
   - i. *Create a "University" database*
   - ii. *Create 2 collections namely "library" with fields usn, name, book_id, borrow_date and "clubs" with fields club_id, club_name, description.*
   - iii. *Display the existing collections.*
   - iv. *Insert a document in each collection.*
   - v. *Explore naming restrictions for collection and document fields.*
5. *Write a program to demonstrate the usage and representation of following data types in MongoDB shell: null, boolean, integer, double, string and array.*
6. *Write a program to demonstrate the usage and representation of following data types in MongoDB shell: object, ObjectId, Date and Timestamp, undefined, min key, max key.*

| | |
|---|---|
| Text Book | Text Book 1: Chapter 1, 2, 3, Text Book 2: Chapter 2, Text Book 3: Chapter 1, 2, 9, 10, 11 |

| MODULE-2 | MONGODB CRUD OPERATIONS | 24MCA254.2 | 3 Hours |
|---|---|---|---|

Introduction to CRUD operations, Creating a Database, Creating a Collection, Inserting Documents into a Collection, Reading Documents, Updating Documents using Various Operators, Array Operators, Using Arrays as Sets, Document Replacement, Updating Multiple Documents, Deleting Documents from a Collection.

**Laboratory Component:** **6 Hours**

1. *Write a program to create a database named "mydb" and set up two collections within it: movies(title, director, year)*
   - *i) Insert one document without object id*
   - *ii) Insert one document with object id*
   - *iii) Insert 5 documents*
   - *iv) Perform bulk insert*
   - *v) Display all the documents*
2. *Write a program to create a collection named webseries( title, episode, director, year) and demonstrate insert and read operations in MongoDB:*
   - *i) Insert one document without object id*
   - *ii) Insert 5 documents*
   - *iii) Display the first document*
   - *iv) Display all the documents*
   - *v) Display documents with only specific fields*
3. *Write a program to illustrate how to modify existing MongoDB documents within the collection "movies":*
   - *i) Update year in one record.*
   - *ii) Update year in first record that matches with given criteria.*
   - *iii) Update year in all records.*
   - *iv) Update multiple records that matches with given criteria.*
   - *v) Add a new field in the collection.*
4. *Write a program to demonstrate various update operators in MongoDB for manipulating arrays within documents.*
   - *i) Create a collection named student (student_id, courses_enrolled). courses_enrolled must be an array and insert 5 documents with atleast 3 courses for each student.*
   - *ii) Append a new course to the array.*
   - *iii) Remove first and last element from the array.*
   - *iv) Add a value to an array only if the value does not already exist in the array.*
   - *v) Add a value in the array in a specific position.*
5. *Write a program to demonstrate various update operators in MongoDB documents within webseries collection.*
   - *i) Add an empty array field "genres" to all documents.*
   - *ii) Multiply the episode number of a specific webseries title by 2.*
   - *iii) Set the year of a specific webseries title to 2023 if its current year is less than 2023.*
   - *iv) Increment the year of a specific webseries title by 1.*
   - *v) Rename the field "director" to "showrunner" in a document with a specific title.*
6. *Write a program to demonstrate replacement of documents and deleting documents within a MongoDB collection named "movies".*
   - *i) Set the year of the movie titled "Titanic" to 1997 if its current year is greater than 1997.*
   - *ii) Replace the entire document of a specific movie with a new document.*
   - *iii) Insert a new movie document titled "The Godfather"*
   - *iv) Delete the movie document where the title is "The Godfather"*
   - v) *Delete all movie documents where the year is less than 2000.*

| | |
|---|---|
| Self-study / Case Study / Applications | CRUD Operations in MongoDB for an E-commerce Platform. |
| Text Book | Text Book 1: Chapter 5, Text Book 2: Chapter 3 |

| MODULE-3 | QUERYING DOCUMENTS FROM MONGODB | 24MCA254.3 | 3 Hours |
|---|---|---|---|

Querying all Documents, Querying Specific Keys in a Document, Querying Specific Documents using Filter Criteria-Query Conditionals, OR Queries, Regular Expressions, Querying Arrays, Querying Embedded Documents, Cursors, Limiting the Number of Results Returned, Skipping a Number of Results and Sorting.

**Laboratory Component:** **6 Hours**

*Create a collection named "book" with the fields: (isbn, bname, author [], year, publisher, price)*

*Create a collection named "employee" with the fields: ( eid, ename, experience, position, salary)*

*Create a collection named "project_member with the fields: {mid, mname, desig, salary, yoj}*

1. *Write a program to demonstratequerying all documents and querying specific keys from a MongoDB document (Use the collection named "book").*
   - *i) Insert 5 documents.*
   - *ii) List all the documents.*
   - *iii) List all book names with author name and isbn.*
   - *iv) Display all the books published by "XXXX".*
   - *v) List all the books published in the year 2018, 2019 and 2020*
2. *Write a program to demonstrate different ways of querying documents in MongoDB (Use the collection named "book").*
   - *i) List the publisher of the book titled "java".*
   - *ii) Sort and display all books in ascending order of book names.*
   - *iii) Sort and display only 3 books in descending order of price.*
   - *iv) Display all the books written by Silberchatz and Kuvempu.*
   - *v) Skip first 2 documents and print the remaining.*
3. *Write a program to demonstratequerying documents using comparison and logical operators in MongoDB (Use the collection named "employee").*
   - *i) Insert 5 documents.*
   - *ii) Find all employees of Age 32.*
   - *iii) Display all employees who do not have their name as "joe".*
   - *iv) Find all employees who are between the age of 18 and 30.*
   - *v) Check for employees whose experience is available in the DB.*
4. *Write a program to demonstratequerying documents using comparison and logical operators from a MongoDB document (Use the collection named "employee").*
   - *i) Find all employees with name as "Anitha" ,"Amit" or "Bhaskar"*
   - *ii) Display the employees whose age is 28 or position is "Tech lead*
   - *iii) Display employee name and position for all employees.*
   - *iv) Display employee name and position for employees of age 42.*
   - *v) Display two employees who hold the position as "Manager".*
5. *Write a program to demonstrate querying array elements in MongoDB.(Use the collection named "book").*
   - *i) Find documents where the author array exactly matches with author ["XXXX", "YYYY"].*
   - *ii) Display documents with second author as "XXXX" using key. index*
   - *iii) Return all author arrays with 3 authors.*
   - *iv) Retrieve Last Element from author array.*
   - *v) Retrieves a subset of elements from the author array.*
6. *Write a program to demonstrate querying and modifying existing data in MongoDB documents.*
   - *i) Display all the project members with salary in range 50000- 75000*
   - *ii) Add an array field project to "XXX".*
   - *iii) Add p2 and p3 projects to "XXX".*
   - *iv) Adda new embedded object "contacts" with "phone" and "email"as array objects to "XXX".*
   - *v) Find the memberwith the phone no: 7864398120 and email:abc@gmail.com*

| Text Book | Text Book 1: Chapter 4, Text Book 2: Chapter 4 |
|---|---|

| MODULE-4 | WORKING WITH INDEXES | 24MCA254.4 | 3 Hours |
|---|---|---|---|
| Introduction, Creating an index, Compound Indexes, Indexing Objects and Arrays, When not to Index, Types of Indexes-Unique Indexes , Partial Indexes, Multikey Indexes, Text Indexes, Wildcard Indexes and Text Search. | | | |
| **Laboratory Component:** **6 Hours**<br>1. *Write a program to demonstrate querying documents using pattern matching operators in MongoDB. (Use the collection named "employee").*<br>*i) Display the details of employees holding the position as "developer" using $regex operator.*<br>*ii) Display the details of employees who are software engineer(case-insensitive).*<br>*iii) List the details of employees whose name starts with 'b'.*<br>*iv) List the employees whose name ends with 'a'.*<br>*v) Find the employees where the name field contains either the word "Anitha" or "Pranav" (case-sensitive).*<br>2. *Write a program to demonstrate single field index creation and its utilization in MongoDB.*<br>3. *Write a program to demonstrate creation and utilization of compound indexes in MongoDB.*<br>4. *Write a program to demonstrate creation and utilization of multi key indexes in MongoDB.*<br>5. *Write a program to demonstrate creation of text index and implementation of textsearch.*<br>6. *Write a program to demonstrate creation and utilization of wildcard index in MongoDB.* | | | |
| Text Book | Text Book 1: Chapter 9, Text Book 2: Chapter 5, 6 | | |
| **MODULE-5** | **AGGREGATION FRAMEWORK, MAP REDUCE, BACKUP AND RESTORE** | **24MCA254.5** | **3 Hours** |
| Introduction to the Aggregation Framework, Stages of the Aggregation Pipeline- project, unwind, match, group, sort, skip, limit, add Fields, out, Classes of Expressions and Accumulators, Single Purpose Aggregation Methods, Map-Reduce-When to use Map-Reduce, Map-Reduce Method, Concept of Backups, Data Restoration, Backup Process, Restore Process. | | | |
| **Laboratory Component:** **6 Hours**<br>1. *Write a program to demonstrate aggregation pipeline and summarize total sales per item. Create a collection named "sales" with fields(item, qty, price, date)*<br>2. *Write a program to demonstrate aggregation pipeline to filter the students with GPA >=3.5 and sort by GPA. Create a collection named "students" with fields(name, age, major_subject, gpa)*<br>3. *Write a program to demonstrate aggregation pipeline to unwind items and calculate total order value. Create a collection named "orders" with fields(order_id, cname ,items[product, qty, price]*<br>4. *Write a program that utilizes the MapReduce operation in MongoDB to calculate the total sales for each product from the 'sales' collection. Store the computed results in a new collection named 'total_sales'.*<br>5. *Write a program to demonstrate the use of MapReduce operation in MongoDB to calculate the total priceper customer from the 'orders' collection. Store the computed results in a new collection named 'order_total'.* | | | |
| Self-study / Case Study / Applications | Replica Set Members and Deployment Architectures, Sharded Cluster Components, Restore a Replica Set from MongoDB Backups, Backup and Restore Sharded Clusters. | | |
| Text Book | Text Book 1: Chapter 6, 7, 11, Text Book 2: Chapter 7, 23 | | |

**CIE Assessment Pattern (50 Marks – Hands On)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 5 | 5 | 4 |
| L3 | Apply | 10 | 10 | 4 |
| L4 | Analyze | 10 | - | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Practical)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 5 |
| L3 | Apply | 20 |
| L4 | Analyze | 20 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**


1) Amit Phaltankar, Juned Ahsan, Michael Harrison, LiviuNedov, MongoDB Fundamentals: A hands-on guide to using MongoDB and Atlas in the real world, 1st Edition, Packt, 2020, ISBN: 9781839210648.
2) Eoin Brazil, Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc, 2019, ISBN: 9781491954461.
3) Pramod J. Sadalage, MartinFowler,NoSQL Distilled: ABrief Guide to the Emerging World of Polyglot Persistence, Upper Saddle River: Addison-Wesley, 2013, ISBN: 9780321826626.


**Reference Books:**


1) Data Modeling with NoSQL Database, Singh, Ajit, and Ahmad, Sultan, N.p., Amazon Digital Services LLC - Kdp, 2021, ISBN:9798730280229
2) The Definitive Guide to MongoDB, The NOSQL Database for Cloud and Desktop Computing, Eelco Plugge, Peter Membrey and Tim Hawkins, Apress, 2010, ISBN: 978-1-4302-3052-6. (E-Book)


**Web links and Video Lectures (e-Resources):**

- https://www.mongodb.com/nosql-explained
- https://www.geeksforgeeks.org/introduction-to-nosql/
- https://www.geeksforgeeks.org/mongodb-backup-and-restoration/
- https://www.coursera.org/learn/introduction-to-nosql-databases?action=enroll#modules
- https://www.udemy.com/course/mongodb-the-complete-developers-guide/?couponCode=SKILLS4SALEA

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Group Discussion on Sharded Cluster Balancer.
- Student Presentations on Hadoop Architecture, Hbase and HIVE.
- Expert Talk on Usability in Industrial Applications.

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## ASP.NET WITH C#

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA255** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:1:2:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **2+4** | **Total Marks** | **100** |
| **Credits** | **03** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA255.1 | Discuss the core features of .NET and C#. |
| 24MCA255.2 | Apply advanced object-oriented programming concepts using C#. |
| 24MCA255.3 | Use advanced graphical user interface components and event-handling mechanisms. |
| 24MCA255.4 | Examine the architecture of ADO.NET and its entity framework. |
| 24MCA255.5 | Analyze the concepts and architecture for web application development using ASP.NET. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA255.1 | 1 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA255.2 | 3 | - | - | - | - | - | - | - | 2 | 1 |
| 24MCA255.3 | 3 | 2 | 1 | 1 | - | - | - | - | 2 | 1 |
| 24MCA255.4 | 3 | 3 | 3 | 2 | - | - | - | - | 2 | 1 |
| 24MCA255.5 | 3 | 3 | 3 | 2 | - | - | - | - | **2** | 1 |

| **MODULE-1** | **INTRODUCTION TO .NET AND C#** | **24MCA255.1** | **3 Hours** |
|---|---|---|---|

.Net**-** Core Features of .NET, the Building Block of .NET Platform(CLR, CTS, CLS), Understanding Common Type System, Common Languages Specification, Common Language Runtime, The Role of .NET Base Class Libraries, C# Features, An Overview of .NET Binaries (Assemblies), The Role of Common Intermediate Language, Assembly Manifest, Command Line Compiler(csc.exe).

**C#-** Need of C#, Creating a Simple C# Console Application, Identifiers and Keywords. Data Types, Variables and Constants: Value Types, Reference Types, Type Conversions, Boxing and Un boxing, Variables and Constants, Expression and Operators- Operator Precedence, Using the ?? (Null Coalescing)Operator, Using the-Scope Resolution Operator and Using the is and as Operators. Control Flow Statements: Selection Statements, Iteration Statements and Jump Statements.

**Laboratory Component:** **6 Hours**

1. *C# program that takes an integer input from the user and prints whether the number is positive, negative, or zero.*
2. *C# program that takes a character input from the user and checks whether the character is a vowel or a consonant.*
3. *C# program that prints the first 10 natural numbers using a for loop.*
4. *C# program that prints the sum of all even numbers between 1 and 50 using a while loop.*
5. *C# program that asks the user to enter a number. The program should keep asking the user for a number until they enter a negative number.*
6. *C# program to print a multiplication table from 1 to 10 using nested loops.*

| Text Book | Text Book 1: Chapter 1, 2, 3, 4, Text Book 2: Chapter 1, 2, 3, 4 |
|---|---|

| **MODULE-2** | **OBJECT-ORIENTED CONCEPTS USING C#** | **24MCA255.2** | **3 Hours** |
|---|---|---|---|

Namespaces, Classes and Objects- Creating a Class, Creating an Object, This keyword, Constructors, Array of Objects, Partial Classes and Methods, Access Modifiers and Properties. Static Members.

Object-Oriented Programming- Encapsulation Accessors, Mutators and Properties. Inheritance- Inheritance and Constructors, Sealed Classes and Sealed Methods, Extension Methods. Compile Time and Runtime Polymorphism, Abstract Classes, and Methods. Interfaces and Inheritance.

**Laboratory Component:** **6 Hours**

1. *Create a base class Animal with a method MakeSound(). Create a derived class Dog that overrides the Make Sound() method. Demonstrate polymorphism by creating an instance of Dog and calling the Make Sound() method..*
2. *Create a class Person with properties for Name, Age, and Gender. Write a method DisplayDetails to print the details of the person. Create an object of the class and call the method..*
3. *Create a class Bank_Account with private fields account Number, balance, and account Holder Name. Provide public methods to Deposit, Withdraw, and Get Balance.*
4. *Create an abstract class Shape with an abstract method Calculate Area(). Create two derived classes Circle and Rectangle that implement the Calculate Area() method.*
5. *Create a base class Vehicle with a method Drive(). Create derived classes Car and Bike that override the Drive() method. Demonstrate polymorphism by creating instances of Car and Bike and calling their Drive() methods.*
6. *Create an interface IMovable with a method Move(). Create classes Car and Robot that implement the IMovable interface.*

| Text Book | Text Book 1: Chapter 5, 6, 7, 8, 9 | | |
|---|---|---|---|
| **MODULE-3** | **GRAPHICAL USER INTERFACE WITH WINDOWS FORMS** | **24MCA255.3** | **3 Hours** |

Introduction, Windows Forms, Event Handling: Delegates and Event-Handling Mechanism. Control Properties and Layout, Labels, Text Boxes and Buttons, Group Boxes and Panels, Check Boxes and Radio Buttons, ToolTips, Mouse-Event Handling, Keyboard-Event Handling, Menus, Month Calendar Control, Date Time Picker Control, Link Label Control, List Box Control, Checked List Box Control, Combo Box Control, Tree View Control, List View Control, Tab Control and Multiple Document Interface (MDI)Windows

**Laboratory Component:** **6 Hours**

1. *Create a Windows Form application with a button. When the button is clicked, change the text of a label to "Button Clicked!".*
2. *Create a Windows Form application with a Text Box and a Button. When the button is clicked, display the text from the Text Box in a Message Box.*
3. *Create a Windows Form application with a Combo Box containing a list of colors. When a color is selected from the Combo Box, change the background color of the form to the selected color.*
4. *Create a Windows Form application with a List Box containing a list of fruits. When a fruit is selected from the List Box, display the selected fruit in a label.*
5. *Create a Windows Form application with a group of Radio Buttons labeled "Male" and "Female". When a Radio Button is selected, display the selected gender in a label.*
6. *Create a Windows Form application with a group of Check Boxes labeled "Java", "C#", and "Python". Display the selected programming languages in a label when the selection changes.*

| Self-study / Case Study / Applications | **E-commerce Shopping Cart:** Develop an E-commerce shopping cart application using Windows Forms, allowing users to browse products, add items to cart, manage cart contents, and proceed through checkout steps. |
|---|---|
| Text Book | Text Book 1: Chapter 11, 12, 13 |

| **MODULE-4** | **DATA ACCESS WITH A .NET** | **24MCA255.4** | **3 Hours** |
|---|---|---|---|

Understanding ADO.NET - Describing the Architecture of ADO.NET, ADO.NET Entity Framework. Connection Strings. Database Connection, SQL Server Database, OLEDBD at a base, and ODBCD at a Source, Command Object, Data Adapters, Creating Data Set from Data Adapter, Paging with Data Adapters, Updating with Data Adapters.

**Laboratory Component:** **6 Hours**

1. *Program that establishes a connection to a SQL Server database and prints a message indicating whether the connection was successful or not.*
2. *Program that connects to a SQL Server database and retrieves all records from a table named Employees. Display the results in the console.*
3. *Program that inserts a new record into the Employees table. Use parameterized queries to avoid SQL injection.*

4. *Program that updates the Title of an employee in the Employees table based on the Employee ID.*
5. *Program that deletes a record from the Employees table based on the Employee ID.*
6. *Program that uses Sql Data Adapter to fill a Data Set with records from the Employees table and displays the data.*

| | |
|---|---|
| Self-study / Case Study / Applications | Develop a comprehensive online bookstore management system using ADO.NET for efficient data access, secure transactions, and detailed reporting capabilities. |
| Text Book | Text Book 1: Chapter 19, 20, Text Book 2: Chapter 8, 9, 10 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **WEB APP DEVELOPMENT WITH ASP.NET** | **24MCA255.5** | **3 Hours** |

Delegates, Events and Exception Handling - Delegates Creating and using Delegates, Multicasting with Delegates. Events: Event Sources, Event Handlers, Events and Delegates, Multiple Event Handlers. Exception Handling: The try/catch/finally statement, Checked and Unchecked Statements.
Web App Development with ASP.NET- Introduction, Web Basics, Multitier Application Architecture, Building Web Application.

**Laboratory Component:** **6 Hours**

1. *C# program that uses a delegate to call methods for squaring and cubing an integer.*
2. *C# program with a Clock class that triggers an event every second, and display the current time in the main program when the event is triggered.*
3. *C# program that reads an integer from the user, divides 100 by the entered number, and handles exceptions for invalid input and division by zero.*
4. *Create a simple ASP.NET MVC web application that displays a list of products on the home page.*
5. *Create a simple ASP.NET Web API that returns a list of products in JSON format.*

| | |
|---|---|
| Text Book | Text Book 1: Chapter 26,27,28 |

**CIE Assessment Pattern (50 Marks – Hands On)**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Qualitative Assessment (s) | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 5 | 5 | 4 |
| L3 | Apply | 10 | 10 | 4 |
| L4 | Analyze | 10 | - | 2 |
| L5 | Evaluate | - | - | - |
| L6 | Create | - | - | - |

**SEE Assessment Pattern (50 Marks – Practical)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 5 |
| L3 | Apply | 20 |
| L4 | Analyze | 20 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Text Books:**

1) Andrew Troelsen, Phil Japikse, "Pro C# 10 with .NET 6: Foundational Principles and Practices in programming", Publisher: Apress, 11th Edition, 2022, ISBN: 13-9781484278680.
2) James Chambers, David Paquette & Simon Timms, "ASP.NET Core Application Development", Publisher: Microsoft Press, 1st Edition, 2017, ISBN: 9781509304066.

**Reference Books:**

1) Matthew MacDonald, "ASP.NET: The Complete Reference", Publisher: McGraw-Hill/Osborne, 2002, ISBN: 9780072195132.
2) Himali, Patel, Kaushal Gor "Web Application Development: Asp.Net With C#", Publisher: Notion Press, 2022, ISBN: 9798886062106.

**Web links and Video Lectures (e-Resources):**

- https://www.coursera.org/learn/dot-net-foundation
- https://www.btechguru.com/training--dot-net--c-sharp-dot-net--framework--c-sharp-programming-tutorial-part-1-video-lecture--11285--27--9
- https://www.w3schools.com/asp/default.ASP
- https://www.javatpoint.com/asp-net-tutorial

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Project-Based Learning: Development of code snippets for solution of real world project components
- Interactive Coding Challenges: Practicing usage of platforms like CodePen, JSFiddle, or Visual Studio Code Live Share for live coding sessions

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## DATA STRUCTURES AND ALGORITHMS LAB

| | | | |
|---|---|---|---|
| **Course Code** | **24MCAL26** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:1.5:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **1.5** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCAL26.1 | Demonstrate array manipulation, string operations, sorting and searching techniques. |
| 24MCAL26.2 | Use stack-based and recursive programming techniques. |
| 24MCAL26.3 | Analyse the operational aspects of queues. |
| 24MCAL26.4 | Analyse linked list implementation of stack and queue data structures. |
| 24MCAL26.5 | Write a program to illustrate heap sort and traverse a binary search tree. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCAL26.1 | 3 | - | - | - | - | - | - | - | - | 3 |
| 24MCAL26.2 | 3 | 2 | - | - | - | - | - | - | - | 3 |
| 24MCAL26.3 | 3 | 2 | - | - | - | - | - | - | - | 3 |
| 24MCAL26.4 | 3 | 2 | 1 | - | - | - | - | - | - | 3 |
| 24MCAL26.5 | 3 | 2 | 1 | - | - | - | - | - | - | 3 |

| Exp. No. / Pgm. No. | List of Experiments / Programs | Hours | COs |
|---|---|---|---|
| | **Prerequisite Experiments / Programs / Demo** | | |
| | • Data Types and Operators in C<br>• Control Statements in C<br>• Conditional and Logical Operations<br>• Writing Functions and Function Calls | 3 | NA |
| | **PART-A** | | |
| 1 | Example programs on arrays:<br>a) Write a C program to find the largest element of a given array of integers.<br>b) Write a C program to sort an array in ascending order using selection sort.<br>c) Write a C program to add two matrices. | 3 | 24MCAL26.1 |
| 2 | Write a C program to perform String operations with user defined functions. | 3 | 24MCAL26.1 |
| 3 | Implement linear and binary search techniques in an array. | 3 | 24MCAL26.1 |
| 4 | Write a C program that uses stack operations to convert a given infix expression into its postfix equivalent. | 3 | 24MCAL26.2 |
| 5 | Write a program in C with recursive functions for the following:<br>a) Fibonacci Series<br>b) Tower of Hanoi | 3 | 24MCAL26.2 |
| 6 | Simulating the working of a linear queue data structure. | 3 | 24MCAL26.3 |
| 7 | Simulating the working of a circular queue data structure. | 3 | 24MCAL26.3 |
| | **PART-B** | | |
| 8 | Write a C program for Linked List implementation of a Stack. | 3 | 24MCAL26.4 |
| 9 | Write a C program for Linked List implementation of a Queue. | 3 | 24MCAL26.4 |
| 10 | Write a C program that uses functions to perform the following:<br>a) Create a doubly linked list of elements. | 3 | 24MCAL26.4 |

| | | | |
|---|---|---|---|
| | b) Delete a given element from the above doubly linked list.<br>c) Display the contents of the above list after deletion. | | |
| 11 | Implement Heap sort technique. | 3 | 24MCAL26.5 |
| 12 | Write a C++ program that uses functions to perform the following:<br>a) Create a binary search tree of integers.<br>b) Traverse the Binary search tree in in-order, pre-order and post-order. | 3 | 24MCAL26.5 |

## PART-C

## Beyond Syllabus Virtual Lab Content

1. To gain a basic understanding of stacks as an abstract data type, understand operations on stack with their applications. Students to complete the learning objectives using virtual laboratory link: https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html.
2. To demonstrate understanding of the concepts of sorting a single dimensional array using any one of the sorting algorithms. Students to complete the learning objectives using virtual laboratory link: https://ds1-iiith.vlabs.ac.in/exp/bubble-sort/index.html.

**CIE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Test (s) | Weekly Assessment |
|---|---|---|---|
| | | 40 | 10 |
| L1 | Remember | - | - |
| L2 | Understand | 10 | 2 |
| L3 | Apply | 20 | 4 |
| L4 | Analyze | 10 | 4 |
| L5 | Evaluate | - | - |
| L6 | Create | - | - |

**SEE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | - |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 20 |
| L5 | Evaluate | - |
| L6 | Create | - |

**Suggested Learning Resources:**

**Reference Books:**

1) Data Structures Using C, Pearson Education, First Edition, 2019, ISBN: 9789332543546.
2) Advanced Data Structures, Anuradha A. Puntambekar Amazon Digital Services LLC - KDP Print US, 2020, ISBN: 9789333223836.

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| ADVANCED JAVA LAB | | | |
|---|---|---|---|
| **Course Code** | **24MCAL27** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:1.5:0** | **SEE Marks** | **50** |
| **Hrs / Week** | **3** | **Total Marks** | **100** |
| **Credits** | **1.5** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCAL27.1 | Discuss the fundamentals of Java Swing in creating Java GUI application. |
| 24MCAL27.2 | Develop programs to implement database operations using JDBC. |
| 24MCAL27.3 | Create dynamic web pages using Servlet. |
| 24MCAL27.4 | Design and develop dynamic web pages using Java Server Pages and Java Beans. |
| 24MCAL27.5 | Use Java beans and JSTL to build web applications. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCAL27.1 | 3 | 1 | 3 | - | - | - | - | - | - | 3 |
| 24MCAL27.2 | 3 | 1 | 3 | - | - | - | - | - | - | 3 |
| 24MCAL27.3 | 3 | 1 | 3 | - | 2 | - | - | 2 | - | 3 |
| 24MCAL27.4 | 3 | 1 | 3 | - | 2 | - | - | 2 | - | 3 |
| 24MCAL27.5 | 3 | 1 | 3 | - | 2 | - | - | 2 | - | 3 |

| Exp. No. / Pgm. No. | List of Experiments / Programs | Hours | COs |
|---|---|---|---|
| | **Prerequisite Experiments / Programs / Demo** | | |
| | • Basics of Object Oriented Programming<br>• Core Java Programming | 3 | NA |
| | **PART-A** | | |
| 1 | Write a Java program to open and save a file in different location. | 3 | 24MCAL27.1 |
| 2 | Create a Java Swing application to display the students performance card. | 3 | 24MCAL27.1 |
| 3 | Write a Java Program to insert data into Student DATA BASE and retrieve info based on particular queries. | 3 | 24MCAL27.2 |
| 4 | Write a Java Servelet Program to implement get and post method | 3 | 24MCAL27.3 |
| 5 | Write a Java Servelet Program to implement verification of a particular user login and display a welcome page using MYSQL. | 3 | 24MCAL27.3 |
| 6 | Write a Java Servlet Program using cookies to remember user Reference. | 3 | 24MCAL27.3 |
| | **PART-B** | | |
| 7 | Write a Java Servlet Program to implement sessions (Using HTTP Session Interface). | 3 | 24MCAL27.3 |
| 8 | Write a Java Servlet Program to implement Request Dispatcher object (use include() and forward() methods). | 3 | 24MCAL27.3 |
| 9 | Write a Java JSP Program to implement mail registration page using MYSQL. | 3 | 24MCAL27.4 |
| 10 | Write a Java JSP Program which uses jsp: include and jsp: forward action to display a Webpage. | 3 | 24MCAL27.4 |
| 11 | Write a Java JSP Program design two page of personal details with proper navigation. | 3 | 24MCAL27.4 |

| | | | |
|---|---|---|---|
| 12 | Write a Java JSP Program to get student information through a HTML and create a JAVA Bean Class, populate Bean and display the same information through another JSP. | 3 | 24MCAL27.5 |

**PART-C**

**Beyond Syllabus Virtual Lab Content**

**(To be done during Lab but not to be included for CIE or SEE)**

- https://www.geeksforgeeks.org/starting-first-servlet-application/
- https://www.educba.com/jsp-in-java/

**CIE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Test (s) | Weekly Assessment |
|---|---|---|---|
| | | 40 | 10 |
| L1 | Remember | 10 | - |
| L2 | Understand | 10 | 5 |
| L3 | Apply | 10 | 5 |
| L4 | Analyze | 10 | - |
| L5 | Evaluate | - | - |
| L6 | Create | - | - |

**SEE Assessment Pattern (50 Marks – Lab)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| L5 | Evaluate | - |
| L6 | Create | 5 |

**Suggested Learning Resources**

**Reference Books:**


1) Developing Enterprise Java Components. Enterprise Java Beans 3.1.O'reilly. Andrew Lee Rubinger, Bill Burke, O'Reilly Media, 2010, ISBN: 9781449396961.
2) EJB 3 Developer Guide, A practical guide for developers and architects to the Enterprise Java Beans Standard, Michael Sikora, Shroff Publishers & Distributors PVT LTD. July 2008, ISBN: 9788184045307.
3) Advanced Java Programming, Prasanalakshmi B, 1st Edition, 2015, CBS Publishing, ISBN: 9788123923833.


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## MINI PROJECT

| | | | |
|---|---|---|---|
| **Course Code** | **24MCA28** | **CIE Marks** | **50** |
| **L:T:P:S** | **0:0:0:2** | **SEE Marks** | **50** |
| **Hrs / Week** | **-** | **Total Marks** | **100** |
| **Credits** | **2** | **Exam Hours** | **03** |

**Course outcomes:**
At the end of the course, the student will be able to:

| | |
|---|---|
| 24MCA28.1 | Apply computing knowledge to the chosen problem domain. |
| 24MCA28.2 | Examine the problem to determine the requirements and objectives of the project. |
| 24MCA28.3 | Use various software tools and techniques to design, develop, and analyze problems in order to draw valid conclusions. |
| 24MCA28.4 | Apply project management principles while adhering to ethical standards. |
| 24MCA28.5 | Function and communicate effectively both independently and as part of a team in project settings, while also actively pursuing independent learning |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24MCA28.1 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| 24MCA28.2 | - | 2 | - | - | - | - | - | - | 2 | 2 |
| 24MCA28.3 | - | - | 3 | 3 | - | - | - | - | 2 | 2 |
| 24MCA28.4 | - | - | - | - | - | 2 | 2 | - | 2 | 2 |
| 24MCA28.5 | - | - | - | - | 3 | - | - | 3 | 2 | 2 |

**Course Details:**

i. Students should undertake a mini project in teams of up to 2 members. The goal of this course is to address problems using cutting-edge technologies.
ii. Each project's title, relevance, originality, synopsis, and the technologies employed will be evaluated by the assigned guides.
iii. The Mini Project can involve either an application development or research work.
iv. The project must be executed by a pair of students. Nevertheless, each student is required to individually present the project during the examination.
v. A concise project report (25-30 pages) must be submitted by the team.

**The following are the suggested contents for the Mini Project Report:**

i. Introduction
ii. Review of Literature
iii. Methodology and Software Requirements Specifications (SRS)
iv. Analysis and Design Implementation (including screenshots with descriptions)
v. Testing
vi. Conclusion
vii. Future Enhancements
viii. Bibliography

The contents in the report may vary depending upon the Project Objectives.

**CIE Assessment Pattern(50 Marks – Lab)**

| Continuous Internal Evaluation | Tests Marks(50) |
|---|---|
| **Problem Identification and literature** | 10 |
| **Data Sampling and Cleaning** | 5 |
| **Objectives** | 5 |
| **Developing the solution** | 10 |
| **Project Report** | 10 |
| **Project Presentation** | 5 |
| **Project Evaluation** | 5 |

**SEE Assessment Pattern(50 Marks – Lab)**

| Semester End Evaluation | Marks(50) |
|---|---|
| **Problem Identification and literature** | **10** |
| **Data Sampling and Cleaning** | **5** |
| **Objectives** | **5** |
| **Developing the solution** | **10** |
| **Project Report** | **10** |
| **Project Presentation** | **5** |
| **Project Evaluation** | **5** |

**Suggested Learning Resources:**
**Web links:**

- https://onlinecourses.swayam2.ac.in/cec20_cs07
- https://onlinecourses.nptel.ac.in/noc19_cs70/
- https://onlinecourses.nptel.ac.in/noc24_mg01/

****

# APPENDICES

# APPENDIX A

## Outcome Based Education

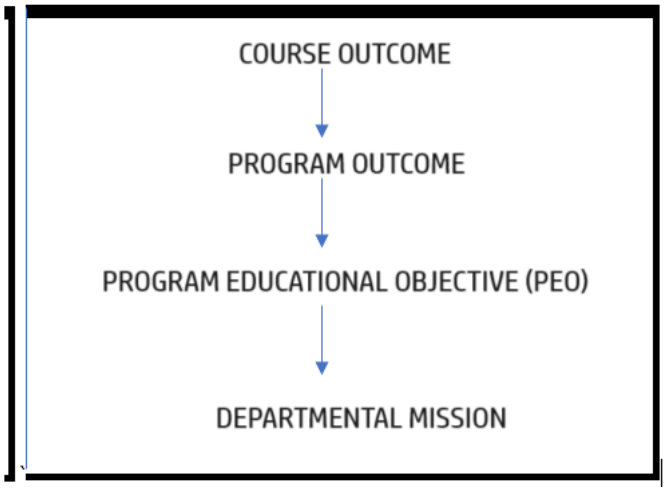
*Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead, classes, opportunities, and assessments should all help students achieve the specified outcomes.*

There are three educational outcomes as defined by the National Board of Accreditation: Program Educational Objectives: The Educational Objectives of the Computer Applications program are the statements that describe the expected achievements of graduate in their career and in particular, what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

***Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix B***

**Course Outcome:** The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes.

**Mapping of Outcome:**



# APPENDIX B

## The Graduate Attributes of NBA

**PO1** **(Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

**PO2** **(Problem Analysis):** Identify, review, formulate and analyse problems for primarily focusing on customer requirements using critical thinking frameworks.

**PO3** **(Development of Solutions**): Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.

**PO4** **(Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

**PO5** **(Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.

**PO6** **(Project Management and Finance):** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

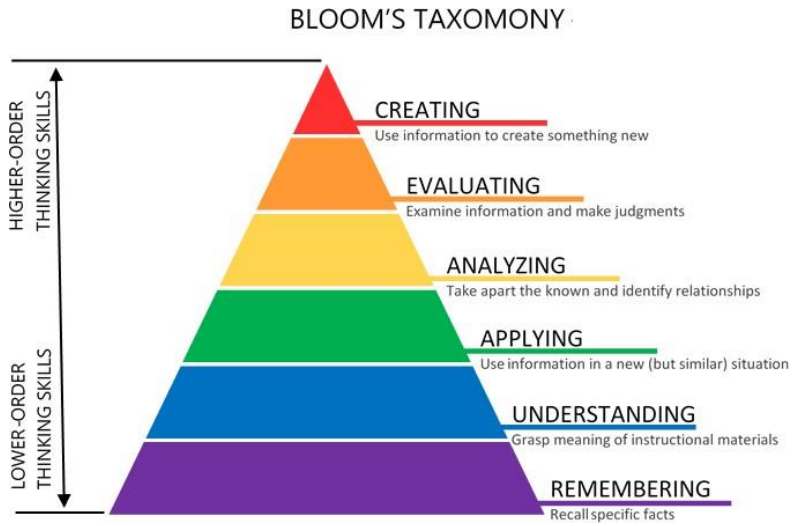
**PO7** **(Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.

**PO8** **(Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

# APPENDIX C

## BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.



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