AUTONOMOUS

SYLLABUS

V & VI Semesters

B.E in
CS&E(Artificial Intelligence & Machine Learning)

2023

MITE

Invent Solutions

MANGALORE INSTITUTE OF
TECHNOLOGY & ENGINEERING

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

SCHEME & SYLLABUS

V/VI SEMESTER B.E.

CS&E(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

2023 Scheme

(W.E.F 2023 Admission Students)

LIST OF COURSES

V/VI Semester			
Sl. No.	**Course Code**	**Course Title**	**Semester**
HUMANITIES & SOCIAL SCIENCE COURSES			
1	**23HMCC301**	Entrepreneurship, Management & Finance	V
PROFESSIONAL CORE COURSES			
2	**23CIPC302**	Database Management Systems	V
3	**23CIPC303**	Computer Networks	V
4	**23CIPC304**	Mathematics for Artificial Intelligence	V
5	**23CIPC305**	Computer Networks laboratory	V
6	**23CIPC306**	Business Intelligence	VI
7	**23CIPC307**	Systems Engineering	VI
8	**23CIPC308**	Artificial Intelligence	VI
9	**23CIPC310**	Business Intelligence laboratory	VI
SKILL ENHANCEMENT COURSE			
10	**23CISE309**	Project Phase-1	
PROFESSIONAL ELECTIVE COURSES			
11	**23CIPE311**	Full stack development	V
12	**23CIPE312**	Machine Learning Operations	V
13	**23CIPE313**	Digital Image processing	V
14	**23CIPE321**	Cryptography and Network security	VI
15	**23CIPE322**	Social Network Analysis	VI
16	**23CIPE323**	Big Data Analytics	VI
OPEN ELECTIVE COURSES			
17	**23CIOE311**	Ethical Hacking	V
18	**23CIOE312**	Introduction to Data Base Management System	V
19	**23CIOE313**	Java Programming	V
20	**23CIOE321**	Digital Forensics	VI
21	**23CIOE322**	Introduction to Machine Learning	VI
22	**23CIOE323**	Introduction to Data Science	VI
AUDIT COURSES			
23	**23NMCC321**	Yoga-III	V
24	**23NMCC322**	Physical Education-III	V
25	**23NMCC323**	National Service Scheme -III	V
26	**23NMCC324**	Arts-III	V
27	**23NMCC325**	Yoga-IV	VI
28	**23NMCC326**	Physical Education-IV	VI
29	**23NMCC327**	National Service Scheme -IV	VI
30	**23NMCC328**	Arts-IV	VI

V Semester (2023 Scheme): CSE(Artificial Intelligence & Machine Learning)

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23HMCC301	Entrepreneurship, Management & Finance	Humanities & Social Science	MBA/Any Department	3	0	0	50	50	100	3	3
2	23CIPC302	Database Management Systems	Professional Core Course	CSE Allied Branches	3	0	2	50	50	100	3	4
3	23CIPC303	Computer Networks	Professional Core Course	CSE Allied Branches	3	0	0	50	50	100	3	3
4	23CIPC304	Mathematics for Artificial Intelligence	Professional Core Course	CSE Allied Branches	2	2	0	50	50	100	3	3
5	23CIPC305	Computer Networks laboratory	Professional Core Course	CSE Allied Branches	0	1	3	50	50	100	2.5	2
6	23CIPE31X	Professional Elective -I*	Professional Elective Course	CSE Allied Branches	3	0	0	50	50	100	3	3
7	23CIOE31X	Open Elective -I**	Open Elective Course	CSE Allied Branches	3	0	0	50	50	100	3	3
8	23NMCC32X	Yoga/ Physical Education/ National Service Scheme/ Arts***	Non Credit Compulsory Course	Yoga Teacher/ PED/NSS Coordinator / Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**21**

Note: MOOC Requirement:

- Students are required to register and successfully complete one MOOC (Massive Open Online Course) of 8 or 12 weeks duration, offered through the NPTEL/SWAYAM platforms, between the 6th and 7th semesters.
- The list of eligible courses shall be approved and notified by the Board of Studies (BoS) of the respective discipline at least 15 days before the start of the semester.

- The successfully completed MOOC will be considered equivalent to a Professional Elective carrying 2 credits, which will be accounted for in the 8th semester.
- Students must submit the course completion certificate and the official score card issued by NPTEL as proof of completion.
- **Failure Policy:** Students who are unable to clear the MOOC in two consecutive attempts during the 6th and 7th semesters will be allowed to register for a Professional Elective course offered by the department in online mode during the 8th semester to earn the required 2 credits. SEE will be conducted by the department in the offline mode.

*** Professional Elective -I Course(s):**

Sl. No.	Course Code	Course Title
1	23CIPE311	Full stack development
2	23CIPE312	ML Ops
3	23CIPE313	Digital Image processing

****Open Elective -I Course(s):**

Sl. No.	Course Code	Course Title
1	23CIOE311	Ethical Hacking
2	23CIOE312	Introduction to Data Base Management System
3	23CIOE313	Java Programming

*****Yoga/Sports/NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23NMCC321	Yoga-III
2	23NMCC322	Physical Education-III
3	23NMCC323	NSS-III
4	23NMCC324	Arts-III

Note: *** To be offered from 3rd to 6th Semester

VI Semester (2023 Scheme): CSE(Artificial Intelligence & Machine Learning)

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23CIPC306	Business Intelligence	Professional Core Course	CSE Allied Branches	3	0	0	50	50	100	3	3
2	23CIPC307	Systems Engineering	Professional Core Course	CSE Allied Branches	2	0	0	50	50	100	2.5	2
3	23CIPC308	Artificial Intelligence	Professional Core Course	CSE Allied Branches	2	0	0	50	50	100	2.5	2
4	23CISE309	Project Phase-I	Project	CSE Allied Branches	-	-	6	100	-	100	-	3
5	23CIPC310	Business Intelligence Laboratory	Professional Core Course	CSE Allied Branches	0	1	3	50	50	100	2.5	2
6	23CIPE32X	Professional Elective-II*	Professional Elective Course	CSE Allied Branches	3	0	0	50	50	100	3	3
7	23CIOE32X	Open Elective -II**	Open Elective Course	CSE Allied Branches	3	0	0	50	50	100	3	3
8	23NMCC32X	Yoga/ Physical Education/ National Service Scheme/ Arts***	Non Credit Compulsory Course	Yoga Teacher/ PED/NSS Coordinator/ Cultural Coordinator	0	0	1	100	-	100	-	-
											Total	**18**

*** Professional Elective -II Course(s):**

Sl. No.	Course Code	Course Title
1	23CIPE321	Cryptography and Network security
2	23CIPE322	Social Network Analysis
3	23CIPE323	Big Data Analytics

****Open Elective -II Course(s):**

Sl. No.	Course Code	Course Title
1	23CIOE321	Digital Forensics
2	23CIOE322	Introduction to Machine Learning
3	23CIOE323	Introduction to Data Science

*****Yoga/Sports/NSS/Arts:**

Sl. No.	Course Code	Course Title
1	23NMCC325	Yoga-IV
2	23NMCC326	Physical Education-IV
3	23NMCC327	NSS-IV
4	23NMCC328	Arts-IV

INDEX

V Semester

Sl.No	Course Code	Course Title	Page No
1.	23HMCC301	Entrepreneurship, Management & Finance	**1**
2.	23CIPC302	Database Management Systems	**3**
3.	23CIPC303	Computer Networks	**8**
4.	23CIPC304	Mathematics for Artificial Intelligence	**10**
5.	23CIPC305	Computer Networks laboratory	**12**
6.	23CIPE31X	Professional Elective -I	**14-21**
7.	23CIOE31X	Open Elective -I	**22-27**
8.	23NCMC32X	Yoga/ Physical Education/ National Service Scheme/ Arts	**28-35**

VI Semester

Sl.No	Course Code	Course Title	Page No
1.	23CIPC306	Business Intelligence	**36**
2.	23CIPC307	Systems Engineering	**38**
3.	23CIPC308	Artificial Intelligence	**40**
4.	23CISE309	Project Phase-I	**42**
5.	23CIPC310	Business Intelligence Laboratory	**45**
6.	23CIPE32X	Professional Elective-II	**50-59**
7.	23CIOE32X	Open Elective -II	**60-65**
8.	23NMCC32X	Yoga/ Physical Education/ National Service Scheme/ Arts	**66-73**

Entrepreneurship, Management & Finance			
Semester	**V**	CIE Marks	**50**
Course Code	**23HMCC301**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart key competencies, qualities, and skills of entrepreneurship.
2. Provide insights into the pathways to new venture creation.
3. Acquaint with the various concepts of management in organizations.
4. Emphasize the importance of the various functions of management in the business.
5. Familiarize the financial aspects of the various forms of organizations.

Module 1: Entrepreneur and Entrepreneurship	**No. of Hrs: 8**

Entrepreneur: Definition, Entrepreneurial competencies, Characteristics of Entrepreneurs, Qualities of an entrepreneur, Entrepreneurial skills. Developing Entrepreneurial competencies, Classification of Entrepreneurs, Entrepreneur vs Professional Managers.
Entrepreneurship: Concept, Phases of Entrepreneurship Development, Fostering Entrepreneurship, Barriers to Entrepreneurship, Factors influencing Entrepreneurship.
Textbook 1: Chapter 2, 3and 10

Module 2: Opportunities and pathways to Entrepreneurship	**No. of Hrs: 8**

Opportunity identification, Sources of Innovative ideas, Entrepreneurial imagination, and creativity, Concept of Creativity, Rules, Components, Process or phases of creativity, the critical thinking process.
Pathways to new ventures: Creating New ventures, Acquiring an established venture, Franchising.
Textbook 2: Chapter 5 and 6

Module 3: Introduction to Management	**No. of Hrs: 8**

Management: Nature, Objectives, Importance. Difference between administration and management. Levels of management, Types of managers, Managerial skills, Managerial Competencies, Scope, or Functional areas of management.
Textbook 3: Chapter 1

Module 4: Management Functions	**No. of Hrs: 9**

Functions of Management: Planning, Organizing, Staffing, Directing and Controlling.
Planning: Meaning, Features, Importance, Types, and steps. Organizing: Meaning, Need, Principles, and Process. Staffing: Meaning, Nature, and Process. Directing: Meaning, Need, Elements and Techniques. Controlling: Meaning, Need, Characteristics, Steps, and Types.
Textbook 3: Chapter 3, 4, 5 and 6

Module 5: Business Organizations and Finance	**No. of Hrs: 9**

Forms of Business Organization: Sole proprietorship, Partnership, Cooperative Society, and Company. Financial decisions in a firm, Goal of Financial Management, Fundamental principle of finance, building blocks of modern finance, Risk-return tradeoff, Emerging role of financial manager in India, Cost profit volume analysis; Profit volume ratio, Break Even Analysis and Margin of safety
Textbook 4: Chapter 1- Section 1.1, 1.2,1.3, 1.4, 1.5, 1.6 and 1.11, Chapter 13 – Section 13.4

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

1. Outline the entrepreneurial skills & qualities required for business developme nt and growth.
2. Describe the processes of opportunity identification, creativity, and pathways to establishing new ventures

3. Explain the fundamental concepts of management.
4. Apply the functions of management in decision-making.
5. Apply the knowledge of financial concepts in solving business Problems.

Text Books:

1. Vasanth Desai, "The Dynamics of Entrepreneurial Development and Management", 6th edition, Himalaya Publishing House, 2018
2. Donald F. Kuratko and T.V. Rao, "Entrepreneurship: A South Asian Perspective", 1st Edition, Cengage Learning, 2017
3. Chandrani Singh and Aditi Khatri, "Principles and Practices of Management and Organisational Behaviour", 5th Edition, Sage Texts, 2021
4. Prasanna Chandra, "Financial Management- Theory and Practice",10th Edition, Mc Graw Hill, 2022

Reference Books:

1. Deependra Sharma, "Entrepreneurship in India",1st Edition, Routledge India, 2023
2. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, and Sabyasachi Sinha, "Entrepreneurship", 11th Edition, McGraw Hill, 2022
3. Charanthimath Poornima M, "Entrepreneurship Development and Small Business Enterprises", 3rdEdition, Pearson, 2018

Web links:

1. Introduction to Entrepreneur: https://www.youtube.com/watch?v=rbmz5VEW90A
2. Pathways to new creations: https://www.youtube.com/watch?v=zkgbss81QKE
3. Concepts of Management: https://www.youtube.com/watch?v=GZ2dmbDmB5I
4. Functions of Management: https://www.youtube.com/watch?v=Vq8GChMK5Zg
5. Types of Business Organizations: https://www.youtube.com/watch?v=UGSlED1Jx1Y

Data base Management System			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIPC302**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**3:0:2**	Exam Hrs	**03**
Total Hrs	**64(40+24)**	Credits	**04**

Course Learning Objectives: This course is designed to

1. Impart foundational knowledge of database concepts.
2. Provide insights of the relational data model and data retrieval operations using relational algebra.
3. Emphasize the importance of normalization for effective database design.
4. Familiarize SQL queries for various data retrieval scenarios

Module 1: Introduction to Databases	**No. of Hrs: 7**

Introduction, Characteristics of database approach, Database Users, Advantages, Evolution of database applications, Disadvantages, Data Models, Schemas, Instances, Three schema architecture, data independence, Database languages, Interfaces, The Database System environment, Centralized and Client/Server architecture of DBMS.

Text Book 1: Chapter 1.1 to 1.9 ,Chapter 2.1 to 2.5

Module 2: Data Models	**No. of Hrs: 9**

Entity types, Entity Sets, structural constraints, Weak entity types, ER diagrams, Naming Conventions and Design Issues.
Relational Model: Concepts, Constraints, relational database schemas, Update operations, Transactions, Dealing with constraint violations.
Relational Algebra: Unary Operations- SELECT and PROJECT, Set Theory - UNION, INTERSECTION and MINUS, Binary Operations - JOIN and DIVISION, Aggregate Functions, Examples Queries, Relational Database Design using ER-to-Relational mapping.

Text Book 1: Chapter 3.3 to 3.7, Chapter 5.1 to 5.3, Chapter 8.1 to 8.5, Chapter 9.1

Module 3: Normalization	**No. of Hrs: 8**

Database Design Theory and Normalization: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multi-valued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Inference Rules.

Text Book 1: Chapter 14.1 to 14.7, Chapter 15.1

Module 4: Query Processing	**No. of Hrs: 9**

SQL data types, DDL, DML and DCL, specifying constraints in SQL, Basic retrieval queries in SQL, Nested and Correlated nested queries, Joined tables, outer joins, Aggregate functions, Assertions, Triggers, Views.

Text Book 1: Chapter 6.1 to 6.4, Chapter 7.1 to 7.4

Module 5: Transaction Management	**No. of Hrs: 7**

Introduction to Transaction Processing, Transaction and System concepts, ACID properties, Characterizing schedules based on serializability, Transaction support in SQL. Two-Phase Locking Techniques, Recovery Concepts, Shadow Paging, ARIES Recovery Algorithm.

Text Book 1: Chapter 20.1, 20.2.1, 20.3, 20.5.1, 20.5.2, 20.6, Chapter 21.1 .1, Chapter 22.1.3, 22.4, 22.5

Laboratory Component:	**No. of Hrs: 24**

I. Create a **Library Management System database system**. The system should help a college library maintain information about **books, students, borrowing activity, and staff**. Add following constraints

- StudentID, ISBN, StaffID, and BorrowID must be **primary keys** in their respective tables.
- StudentID and ISBN in BorrowedBooks must be **foreign keys** referencing Students and Books.
- Ensure Email in Students is **unique**.
- Ensure Copies Available is a **non-negative integer**.
- Add **NOT NULL** constraints to all essential fields.

(Use CREATE TABLE statements to define the schema, and show that the constraints are properly set using DESCRIBE or SHOW CREATE TABLE)

Hint: *Each student has an ID, name, department, email, and year of study., Each book has a unique ISBN, title, author, publisher, and number of copies available., Each staff member has an ID, name, position, and contact number. Borrowing activity: which student borrowed which book, on what date, and when it is due for return.*

II. Design a database for managing the data for an **Online Food Delivery System** that allows customers to order food from various restaurants. Create a database containing the following tables:

- **Customers**(CustomerID, Name, Phone, Email, Address)
- **Restaurants**(RestaurantID, Name, Location, Cuisine)
- **MenuItems**(ItemID, RestaurantID, ItemName, Price)
- **Orders**(OrderID, CustomerID, ItemID, Quantity, OrderDate, Status)

Demonstrate following operations:

1. Add 3 new customers.
2. Add a new restaurant and at least 3 menu items for it.
3. Record a few new orders placed by customers for menu items.
4. Update the phone number of a customer.
5. Change the price of a menu item (e.g., increase price by 10%).
6. Update the status of an order to "**Delivered**".
7. Delete a customer who has not placed any orders.
8. Delete a menu item that is no longer available.
9. Delete an order that was cancelled by the customer

III. You are managing data for a **Hospital Management System**. The system has several interrelated tables storing information about **patients, doctors, appointments**, and **treatments**. Create a database containing the following tables:

- **Patients**(PatientID, Name, Gender, Age, Phone)
- **Doctors**(DoctorID, Name, Specialty, Phone)
- **Appointments**(AppointmentID, PatientID, DoctorID, AppointmentDate, Status)
- **Treatments**(TreatmentID, AppointmentID, Diagnosis, Prescription, Cost)

Demonstrate the following operations

1. Retrieve the names and phone numbers of all patients above age 60.
2. List all doctors who specialize in "**Cardiology**".
3. Find all appointments that are marked as "**Pending**".
4. Retrieve the name of each patient, the doctor they visited, and the date of the appointment.
5. Show the doctor name, specialty, and total number of appointments they have handled.
6. List all patients with their prescribed treatment and the cost, even if some appointments do not have treatments yet.
7. Find patients who have visited doctors specializing in "**Dermatology**".
8. Get a list of all appointments along with patient name, doctor name, diagnosis, and cost (if available).

IV. The database of an **E-Commerce Order Management System** tracks **customers**, their **orders**, and the **products** they purchase. Create a database containing the following tables:

- **Customers**(CustomerID, Name, City)
- **Products**(ProductID, ProductName, Category, Price)
- **Orders**(OrderID, CustomerID, OrderDate, TotalAmount)
- **OrderItems**(OrderItemID, OrderID, ProductID, Quantity, UnitPrice)

Demonstrate the following operations

1. Find all customers who placed an order with a total amount **grea er than the average order amount**.
2. List the names of products that have a **higher price than the most expensive product in the 'Books' category**.
3. Retrieve the names of customers who **have never placed any order**.
4. List all customers who have **ordered more than 3 different products**.
5. Find the names of products that have been **ordered more than once by the same customer.**
6. Display customers who have placed **at least one order in the last 30 days**, along with the number of such orders.
7. Show the product(s) with the **highest unit price** in each category.
8. List the names of customers **whose every order total is above ₹500.**

V. Create a database for developing reports for a **University Student Management System** that maintains academic data about students, courses, and grades with following tables

- **Students** (StudentID, Name, Department)
- **Courses** (CourseID, CourseName, Credits)
- **Enrollments** (EnrollmentID, StudentID, CourseID, Semester, Grad)

Demonstrate the following operations

1. Count the number of students enrolled in each department.
2. Calculate the**average grade per course**.
3. List the **total number of courses taken by each student**.
4. Find the **highest and lowest grade** received in each course.

5. Get the **total number of students enrolled in each course**.
6. List all courses where the **average grade is greater than 75**.
7. Find students who have enrolled in **more than 5 courses**.
8. Display departments with **more than 100 students**.
9. Identify the course(s) with the **maximum enrollments** in a given semester.
10. Show students who have a **cumulative average grade greater than 80**.

VI. You are managing the backend for an Employee Payroll System in a company. The HR department maintains a EMPLOYEE table containing the following fields: EmpID, Name, Department, Designation, and Salary. The company wants to track salary changes to ensure transparency and detect unauthorized modifications. Any time a new employee is added, an existing employee's salary is updated, or an employee record is deleted, a trigger should automatically fire. In particular, for salary updates, the system should calculate and display the difference between the old salary and the new salary.

VII. You are developing an automated HR system for a mid-sized company that tracks employee performance, promotions, and compensation. The EMPLOYEE table stores key employee information including: EmployeeID, Name, Department, Salary, Rank, and Bonus. To support fair promotion policies and ensure accurate compensation calculations, the company enforces the following rules:

1. **Promotions Based on Salary Increases**: If an employee's salary is increased by more than 10%, they are considered for a performance-based promotion. The system should automatically increment the employee's Rank by 1.
2. **Bonus Synchronization**: The company provides a bonus of 3% of the employee's current salary. Whenever the salary is updated, the Bonus field must automatically be updated to reflect 3% of the new salary value.

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

1. Describe relational database concepts and transaction management.
2. Apply relational data model concepts to design a database.
3. Apply normalization techniques to minimize data redundancy.
4. Apply relational data model operations for effective retrieval.

Text Book:

1. **Fundamentals of Database Systems**, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, Pearson, 2017.

Reference Books:

1. **Database management systems**, Ramakrishnan, and Gehrke, 3rd Edition, McGraw Hill, 2014.
2. SilberschatzKorth and Sudharshan, **Database System Concepts**, 7th Edition, Mc-GrawHill, 2019.
3. Coronel, Morris, and Rob, **Database Principles Fundamentals of Design, Implementation Management**, 10th Edition, Cengage Learning, 2014.

Web links:

1. Database Languages: https://www.youtube.com/watch?v=9TwMRs3qTcU
2. ER Model: https://www.youtube.com/watch?v=ZWl0Xow304I
3. Relational Algebra: https://www.youtube.com/watch?v=4YilEjkNPrQ
4. ER Diagram to ER Model:https://www.youtube.com/watch?v=CZTkgMoqVss
5. Basic SQL Queries:https://www.youtube.com/watch?v=Hl4NZB1XR9c
6. Normal Forms: https://www.youtube.com/watch?v=EGEwkad_llA
7. Transaction & Concurrency Control: https://www.youtube.com/watch?v=t5hsV9lC1rU

Computer Networks			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIPC303**	SEE Marks	**50**
Teaching Hrs/Week (L: T: P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart the knowledge of the TCP/IP protocol suite, switching mechanisms, and Medium Access Control protocols for both reliable and noisy communication channels.
2. Provide insight into network layer functionalities and Internet Protocol (IP)
3. Provide knowledge on transport layer operations and characteristics of UDP and TCP protocols.
4. Impart knowledge on application layer protocols and their real-world applications.

Module 1: Introduction and Physical layer	**No. of Hrs: 8**

Introduction: Data Communications, Networks, Network Types, Network Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: signals, signal impairment, multiplexing. Switching: Packet Switching and its types.

Text Book 1: Chapter 1, Chapter 2, Chapter 3, Chapter 8

Module 2: Data Link Layer	**No. of Hrs: 9**

Data Link Layer: Framing, Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. Data link control: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. Media Access Control: Random Access, Controlled Access. Check Sum and Point to Point Protocol, Ethernet: Standard Ethernet.

Text Book 1: Chapter 10, Chapter 11,Chapter 12, Chapter 13.2

Module 3: Network Layer	**No. of Hrs: 8**

Network layer Services, performance, IPv4 Address, IPv4 Datagram, IPv6 Datagram, Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unica t Routing protocols: RIP, OSPF, Multicasting Routing-MOSPF
Text Book 1: Chapter 18, Chapter 19.1, Chapter 20, Chapter 21.3.2

Module 4: Transport Layer	**No. of Hrs: 8**

User Datagram Protocol: UDP Services, applications, Transmission Control Protocol: TCP services, features, segments, TCP connections, flow control, Error control, Congestion control.

Text Book 1: Chapter 24

Module 5: Application Layer	**No. of Hrs: 9**

Introduction, Client-Server Programming, Socket interface programming. Standard Client-Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System(DNS), Secure Shell (SSH),

Text Book 1: Chapter 25.1,25.2 Chapter 26

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

1. Explain the components and layered architecture of the TCP/IP protocol suite.
2. Apply data link layer techniques in network communication.
3. Demonstrate the application of routing protocols to facilitate network layer functionalities.
4. Apply transport layer protocols for TCP/UDP services, connections, and flow control mechanisms.
5. Illustrate application layer protocols in real word application

Text Book:

1. Behrouz A. Forouzan, Data Communications and Networking with TCP-IP Protocol Suite, 5th Edition, Tata McGraw-Hill, 2022.

Reference Books:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.
2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education,2015
3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc.,2014.

Web links:

1. Computer Networks and Internet Protocol: https://www.digimat.in/nptel/courses/video/106105183/L01.html
2. Computer Networks: Crash Course: https://www.youtube.com/watch?v=3QhU9jd03a0
3. Computer networks: https://nptel.ac.in/courses/106105080

Mathematics for Artificial Intelligence			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIPC304**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:2:0**	Exam Hrs	**03**
Total Hrs	**26+26**	Credits	**03**

Course Learning Objectives: This course is designed to

1. **Familiarize** foundational concepts of dimensionality reduction.
2. **Provide theoretical knowledge** on probabilistic reasoning to modeling of uncertainty through Bayesian networks, MDPs, and reinforcement learning.
3. **Impart basic knowledge** on various optimization techniques used in Artificial Intelligence models.
4. **Impart** foundational understanding of mathematic concepts used in neural network architectures.

Module 1: Vectors and Matrix Decomposition	**No. of Hrs: 5+5**

Vector Spaces, Linear Independence, Basis & Rank, Norms, Inner Product, Lengths & Distances, Orthogonal Projections, Rotations, Matrix Decompositions: Eigenvalues and Eigenvector, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation

Text book 1: Ch 2,3, 4

Module 2: Markov Chain Process &Dimensionality Reduction	**No. of Hrs: 6+5**

Principal Component Analysis: Problem Setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low-Rank Approximations. Reinforcement Learning (RL), Uncertain knowledge and reasoning: Uncertainty, Probability, Joint probability, Baye's theorem, Bayesian belief network, Inference in belief network, temporal model, Markov Decision process (MDP)

Text book 1: Ch 10

Text book 2 : Ch 11.12 &Ch 12

Module 3: Neural network Mathematics	**No. of Hrs: 5+6**

The Brain Cortex and Artificial Neural Networks, Training Function: Fully Connected, or Dense, Loss Functions, Optimization, Regularization Techniques, Hyperparameters in Machine Learning, Chain Rule and Backpropagation, Assessing the Significance of the Input Data Features.

Text book 3 : Ch 4

Module 4: Convolution Neural Networks and Computer Vision	**No. of Hrs: 5+5**

Convolution and Cross-Correlation, Convolution from a Systems Design Perspective, Convolution and One-Dimensional Discrete Signals, Convolution and Two-Dimensional Discrete Signals: Filtering Images, Feature Maps, Linear Algebra Notation, Pooling, Convolution Neural Network for Image Classification.

Text book 3 : Ch 5

Module 5: Probabilistic Generative Models	**No. of Hrs: 5+5**

Generative Models applications, Mathematics of Generative Models, Probabilistic Thinking, Maximum Likelihood Estimation, Explicit and Implicit Density Models, Explicit Density-Tractable: Fully Visible Belief Networks : PixelCNN, WaveNet, Impli it Density-Markov Chain: Generative Stochastic Network, Implicit Density-Direct: Generative Adversarial Networks, Example: Machine Learning and Generative Networks for High Energy Physics.
Text book 3 : Ch 8

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

1. Apply vector space concepts and matrix decomposition techniques such as SVD and eigen decomposition to solve problems in data representation and dimensionality reduction.
2. Apply Principal Component Analysis for dimensionality reduction and Markov Decision Processes to model decision-making under uncertainty.
3. Apply mathematical principles of neural networks, including loss functions and Back propagation to build and train predictive models.
3. Apply probabilistic generative modeling techniques, including GANs and autoregressive models for synthetic data generation and learning complex distributions.

Textbooks:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, " Mathematics for Machine Learning, 1st Publication year 2020.
2. Dr. Neelakshi Jain, "Artificial Intelligence making a system intelligence" willy publication, 1st edition 2019
3. Hala Nelson, "Essential Math for AI: Next-Level Mathematics for Efficient and Successful AI Systems, **O'Reilly Media** Publication, 2023

Reference Books:

1. Gilbert Strang**"Linear Algebra and Its Applications"**
2. S. Saitoh& Yoshihiro Sawano**"Hilbert Spaces: A Problem Solving Approach"**

Web links:

1. NPTEL Course on Mathematics for Machine Learning
   https://onlinecourses.nptel.ac.in/noc24_ma61/preview
2. Essential Mathematics for Machine Learning
https://onlinecourses.nptel.ac.in/noc21_ma38/preview
3. Mathematics for Machine Learning Tutorial (3 Complete Courses in 1 video)
   https://www.youtube.com/watch?v=0z6AhrOSrRs
4. Math for Machine Learning
   https://www.youtube.com/playlist?list=PLD80i8An1OEGZ2tYimemzwC3xqkU0jKUg

Computer Networks Laboratory			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIPC305**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**0:1:3**	Exam Hrs	**2.5**
Total Hrs	**36**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Impart knowledge to simulate and analyze network topologies and data communication protocols using tools like Cisco Packet Tracer and Python.
2. Provide knowledge on network programming techniques to implement and troubleshoot application and network layer protocols using Python and Wireshark.
3. Impart knowledge to Analyze and interpret packet-level network behavior including routing, addressing, protocol communication, and data transmission performance using real-time tools and scripts.

Laboratory Component: **No. of Hrs: 36**

1. **Simulation of Bus, Ring, and Star Topologies** using Packet Tracer and Observe data flow and collision handling
2. **Implementing Data Link Layer Protocol** – Stop-and-Wait ARQ
3. **Implementing Data Link Layer Protocol** – Sliding Window Protoco
4. **IP Addressing and Subnetting:** Design subnetting schemes and assign IP addresses using Packet Tracer. Use DHCP server configuration
5. **Static and Dynamic Routing Configuration:** Configure routing tables manually and Observe path changes using dynamic routing protocols. Use Packet Tracer.
6. **VLAN Configuration on Switches:** Implement VLANs and observe inter-VLAN communication. Configure multiple VLANs -Configure router-on-a-stick for inter-VLAN routing. Use Packet Tracer
7. **Implementing Network Layer Protocol – IP Packet Fragmentation and Reassembly:** Simulate IP packet fragmentation-Implement packet fragmentation logic and Reassembly at the destination
8. **Implementing Application Layer Protocol – Simple Client-Server (HTTP, DNS, FTP):** Create simple client-server models to simulate application layer protocols- HTTP server/client- DNS resolution- FTP file transfer. Use Python (Sockets), Wireshark
9. **Packet Sniffing and Analysis Using Wireshark:** Capture and analyze packets at all layers.-Analyze TCP 3-way handshake- Observe ARP, DHCP, DNS packets- Filter protocols in Wireshark
10. **Monitoring Network Traffic Using Python/Bash Scripts:** Write a script to monitor incoming and outgoing traffic- Display traffic per interface- Store data in logs.Use Python, psutil, nload, iftop

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

1. Apply network simulation tools to configure and analyze different network topologies and routing techniques including static and dynamic routing protocols.
2. Implement data link and network layer protocols such as Stop-and-Wait ARQ, Sliding Window, and IP packet fragmentation using simulation and programming tools.
3. Develop and test simple network applications and scripts for client-server communication, protocol analysis, and traffic monitoring using Python and Wireshark.

Text Book:

1. Behrouz A. Forouzan, Data Communications and Networking with TCPIP Protocol Suite, 5th Edition, Tata McGraw-Hill,2022.

Reference Books:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.
2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education,2015
3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc.,2014.

Web links:

1. Packet tracer introductory course: https://www.netacad.com/courses/getting-started-cisco-packet-tracer?courseLang=en-US

Full Stack Development			
Semester	**V**	CIE arks	**50**
Course Code	**23CIPE311**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**26+26**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impart knowledge of JavaScript and DOM for interactive web development.
2. Provide insights into the MERN stack and React component development.
3. Teach state management, event handling, and component communication in React.
4. Develop skills in building RESTful APIs with Express and using GraphQL.
5. Provide insights into backend development with Node.js and MongoDB.

Module 1: JavaScript and DOM Manipulation	**No. of Hrs: 6**

Basic JavaScript Instructions, Statements, Comments, Variables, Data Types, Decisions & Loops, Functions, Methods & Objects, Functions & Methods, Objects & Arrays.
DOM Manipulation, Selecting Elements, Working with DOM Nodes, Updating Element Content & Attributes, Events, Different Types of Events, How to Bind an Event to an Element, Event Delegation, Event Listeners.

Text Book 1: Chapter 2, Chapter 3,Chapter 4, Chapter 5, Chapter 6

Module 2: MERN and React Components	**No. of Hrs: 5**

Introduction to MERN: MERN components, Serverless Hello world program.
React Components: Issue Tracker, React Classes, Composing Components, Passing Data Using Properties, Passing Data Using Children, Dynamic Composition.

Text Book 2: Chapter 1, Chapter 3

Module 3: React State	**No. of Hrs: 5**

React State: Initial State, Async State Initialization, Updating State, Lifting State Up, Event Handling, Stateless Components, Designing Components, State vs. Props, Component Hierarchy, Communication, Stateless Components

Text Book 2: Chapter 4

Module 4: Express and APIs	**No. of Hrs: 5**

Express: Routing, Request Matching, Route Parameters, Route Lookup, Handler Function, Request Object, Response Object, Middleware, REST API, Resource Based, HTTP Methods as Actions, GraphQL, Field Specification, Graph Based, Single Endpoint, Strongly Typed, Introspection, Libraries, The About API GraphQL Schema File, The List API, List APIIntegration, Custom Scalar types, The Create API, Create API Integration, Query Variables, Input Validations, Displaying Errors.

Text Book 2: Chapter 5

Module 5: Node JS and MongoDB	**No. of Hrs: 7**

Node JS: Setting up Node.js, Callbacks and Events, File System, Buffers & Streams. **MongoDB:** Basics, Documents, Collections, Databases, Query Language, Installation, The Mongo Shell, MongoDB CRUD Operations, Create, Read, Projection, Update, Delete, Aggregate, MongoDB Node.js Driver, Schema Initialization, Reading from MongoDB, Writing to MongoDB
Text Book 2: Chapter 6

Laboratory Component:	**No. of Hrs: 26**

1. Write a script that logs "Hello, World!" to the console. Create a script that calculates the sum of two numbers and displays the result in an alert box.

2. Create an array of 5 cities and perform the following operations:
   - Log the total number of cities.
   - Add a new city at the end.
   - Remove the first city.
   - Find and log the index of a specific city.

3. Read a string from the user, Find its length. Extract the word "JavaScript" using substring() or slice(). Replace one word with another word and log the new string. Write a function is Palindrome(str) that checks if a given string is a palindrome (reads the same backward).

4. Create an object student with properties: name (string), grade (number), subjects (array), displayInfo() (method to log the student's details).
   Write a script to dynamically add a passed property to the student object, with a value of true or false based on their grade. Create a loop to log all keys and values of the student object.

5. Create a button in your HTML with the text "Click Me". Add an event listener to log "Button clicked!" to the console when the button is clicked. Select an image and add a mouseover event listener to change its border color. Add an event listener to the document that logs the key pressed by the user.

6. Build a React application to track issues. Display a list of issues (use static data). Each issue should have a title, description, and status (e.g., Open/Closed). Render the list using a functional component.

7. Create a component Counter with a state variable count initialized to 0. Create buttons to increment and decrement the count. Simulate fetching initial data for the Counter component using useEffect (functional component) or componentDidMount (class component). Extend the Counter component to double the count value when a button is clicked. Reset the count to 0 using another button.

8. Install Express (npm install express).Set up a basic server that responds with "Hello, Express!" at the root endpoint (GET /).

9. Create a REST API. Implement endpoints for a Product resource:
   - GET /products: Returns a list of products.
   - POST /products: Adds a new product.
   - GET /products/:id: Returns details of a specific product.
   - PUT /products/:id: Updates an existing product.
   - DELETE /products/:id: Deletes a product.

   Add middleware to log requests to the console. Use express.json() to parse incoming JSON payloads.

10. Install the MongoDB driver for Node.js. Create a Node.js script to connect to the shop database. Implement insert, find, update, and delete operations using the Node.js MongoDB driver.

11. Define a product schema using Mongoose. Insert data into the products collection using Mongoose. Create an Express API with a /products endpoint to fetch a l products.
12. Use fetch in React to call the /products endpoint and display the list of products. Add a POST /products endpoint in Express to insert a new product. Update the Product List: After adding a product, update the list of products displayed in React.
Course Outcomes: At the end of the course, the student will be able to 1. Design dynamic web pages using JavaScript and DOM manipulation. 2. Build reusable React components and understand MERN stack architecture. 3. Implement state management, event handling, and component interactions in React. 4. Develop and integrate RESTful APIs using Express and explore GraphQL. 5. Apply Node.js and MongoDB for backend development and data management.
Text Books: 1. "JavaScript & jQuery: Interactive Front-End Web Development" by Jon Duckett 2014 John Wiley & Sons 2. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian. Apress, 2019.
Reference Books: 1. Juha Hinkula "Full Stack Development with Spring Boot 3 and React: Build modern web applications using the power of Java, React, and TypeScript".
Web links: 1. NPTEL Course: Joy of Computing Using Python: https://nptel.ac.in/courses/106106156 2. NPTEL Course: Database Management System: https://archive.nptel.ac.in/courses/106/105/106105084/

Machine Learning Operations			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIPE312**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**26+24=50**	Credits	**03**

Course Learning Objectives: This course is designed to

1. **Impart** the fundamental concepts of Machine Learning Operations and its role in model selection.
2. **Process** in different machine Learning model development, versioning, and reproducibility principle.
3. **Familiarize** best practices for deploying machine learning models using modern DevOps tools.

Module 1: Introduction to MLOps	**No. of Hrs: 5+2**

Defining MLOps and Its Challenges, MLOps to Mitigate Risk, MLOps for Scale, People of MLOps, Subject Matter Experts, Key MLOps Features, A Primer on Machine Learning, Model Development, Productionalization and Deployment, Monitoring, Iteration and Life Cycle, Governance.

Textbook 1: Part I (1,2,3)

Experiment 1: Set up GitHub/GitLab for ML project versioning.
Familiar with Git commands.
Use git for tracking model and code changes.

Module 2: Process in Model Development and Versioning	**No. of Hrs:5+4**

Machine Learning Model, ML Required Components, Different ML Algorithms and Different MLOps Challenges**,** Data Exploration, Feature Engineering and Selection, Experimentation, Evaluating and Comparing Models, Version Management and Reproducibility. Textbook 1: Part II (4)

Experiment 2: Experiment Tracking with MLflow

- Train a simple ML model (e.g., logistic regression).
- Log parameters, metrics, and artifacts using MLflow.

Module 3: Preparing for Production & CI/CD Pipelining	**No. of Hrs: 5+4**

Runtime environments, Model risk evaluation, Quality assurance for ML, Key testing consideration, Reproducibility & Auditability, ML security, Model risk mitigation, Deploying to production: CI/CD Pipelines for ML, Building ML Artifacts, Deployment strategies, Containerization, Scaling Deployments, Requirements & Challenges.

Textbook 1: (5.6)

Experiment 3: Implementing CI/CD for ML Models

- Set up a CI/CD pipeline using GitHub Actions.
- Automate model training and testing on code commits.

Module 4: Monitoring, Feedback Loop & Governance	**No. of Hrs: 6+4**

Model retrainment, Understanding Model Degradation, Drift detection in practice, Feedback loop, Model Governance, Matching governance with risk level, Current Regulations Driving, The New Wave of AI-Specific Regulations and Emergence of responsible AI.
Textbook 1: (6,7,8)

Experiment 4:**Containerizing the Model:**

- Train a simple ML model (e.g., a classification model using scikit-learn).
- Save the model using joblib or pickle.
- Write a Flask or FastAPI app to serve the model as an API.
- Create a Dockerfile to containerize the model.
- Build and run the Docker container.

Module 5: MLOps in Practice	**No. of Hrs: 5+4**

Consumer credit risk management: Model development. Model bias consideration, prepare & deploy for production. **Marketing Recommendation Engines**: Data preparation, Design & manage experiment, Model training & Deployment. **Consumption forecast**: Power Systems, Data Collections.
Textbook 1: (9,10,11)

Experiment 5:

a) **Developing a Credit Risk Model**:
   - Use a dataset like German Credit Risk Dataset or Home Credit Default Risk.
   - Train a classification model (Logistic Regression, Random Forest, or XGBoost) to predict loan default probability.
   - Track the model lifecycle using MLflow (versioning, experiment tracking).

b) **Creating a Continual Learning Model:**
   - Train a recommendation engine using the MovieLens dataset.
   - Set up an online learning pipeline that updates the model with new user interactions.

Mini Project	**No. of Hrs: 6**

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

1. **Understand** the fundamentals of MLOps, ML model deployment and its significance.
2. **Compare** various model versioning techniques and experiment tracking methods.
3. **Implement** model deployment strategies using Docker, Kubernetes, and cloud-based solutions.
4. **Apply** ML models in production, detecting performance degradation and drift.
5. **Develop** an end-to-end MLOps workflow by integrating best practices in automation and testing.

Textbooks:

1. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, Introducing MLOps: How to Scale Machine Learning in the Enterprise, Sebastopol, CA, USA: O'Reilly Media, 2020.
2. Emmanuel Raj, Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale, Packt Publishing, 2021

Reference Books:

1. Saurabh D. Dorle, Ultimate MLOps for Machine Learning Models, AVA Publishing, 2024.
2. Mason Leblanc, MLOps Mastery: Building and Scaling Trustworthy AI Systems and Robust ML Pipelines with Machine Learning Operations, 2024.

Web links:

1. Free code camp course MLOps Course – Build Machine Learning Production Grade Projects: https://www.youtube.com/watch?v=-dJPoLm_gtE
2. Github MLOps-course: https://github.com/GokuMohandas/mlops-course
3. Github MLOps-course: https://github.com/ashishpatel26/Awesome-MLOps-Course-Outline

Digital Image Processing			
Semester	**V**	CIE Marks	50
Course Code	**23CIPE313**	SEE Marks	50
Teaching Hrs/Week(L:T:P)	**3:0:0**	Exam Hrs.	3
Total Hrs	**42**	Credits	3

Course Learning Objectives: This course is designed to

1. Impart Knowledge on image acquisition, sampling, quantization, and applications in image processing.
2. Emphasize spatial and frequency domain techniques to enhance digital images.
3. Provide knowledge on image segmentation techniques like edge detection, thresholding, and region-based methods.
4. Impart Knowledge on Extract and describe boundary, region, and whole-image features for image analysis.
5. Provide knowledge to analyze and classify patterns using prototype matching, statistical methods, and neural networks.

Module 1: Image Processing Foundations	**No.ofHrs:7**

Introduction: Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision

Text Book-1:Chapter-2.1,2.2,2.3,2.4

Module 2: Image Enhancement	**No.ofHrs:9**

Image Enhancement: Basic Intensity Transformation Functions, Histogram Processing, Fundaments of Spatial Filtering, Image enhancement process in frequency domain, Low pass and High pass Filters.
Morphological Image Processing: Morphology, Basic Morphological techniques, Morphological Reconstruction.

Text Book-1:Chapter–3.2,3.3,3.4,3.5,3.6 Chapter–9.1,9.5,9.6

Module 3: Image Segmentation	**No.ofHrs:9**

Image Segmentation: Fundaments, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging. Region Segmentation using Clustering and Super pixels, Region Segmentation Using Graph Cuts.

Text Book-1:Chapter– 10.1,10.2,10.3,10.4,10.5,10.6

Module 4: Feature Extraction	**No.ofHrs:9**

Feature Extraction: Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features.

Text Book-1:Chapter–11.1,11.2,11.3,11.4,11.5,11.6

Module 5: Image Pattern Classification	**No.ofHrs:8**

Pattern Analysis: Patterns and Pattern Classes, Pattern Classification by Prototype Matching, Optimum (Bayes) Statistical Classifiers, Neural Networks and Deep Learning.

Text Book-1: Chapter–12.2, 12.3, 12.4, 12.5.

Course Outcomes: At the end of the course the student will be able to

1. Explain Image acquisition, enhancement, segmentation, feature extraction, and classification
2. Apply spatial and frequency domain techniques to improve the quality of digital images.
3. Apply segmentation methods such as edge detection, thresholding, and region-based techniques
4. Apply feature extraction methods for image processing
5. Use classification approaches like prototype matching, statistical methods, and neural networks for pattern recognition.

Text Book:

1. DigitalImageProcessing-4thedition-RefaelC.GonzalezandRichardE.W ods

Reference Books:

1. ComputerVision-Amodernapproach,byD.ForsythandJ.Ponce,PrenticeHall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. ComputerVision,D.H.Ballard,C.M.Brown,Prentice-Hall,EnglewoodCliffs,1982.

Weblinks:

1. Full course**:** https://onlinecourses.nptel.ac.in/noc19_cs58/preview
2. Full course: https://onlinecourses.nptel.ac.in/noc19_ee55/preview

Ethical Hacking			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIOE311**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives:

1. Equip students with a comprehensive understanding of the ethical implications, legal considerations, and best practices associated with ethical hacking.
2. Teach students various methodologies for conducting penetration tests, including reconnaissance, enumeration, and exploitation, to assess system security effectively.
3. Introduce industry-standard tools such as Nmap and Metasploit for vulnerability assessment, network scanning, and exploitation techniques.
4. Cover documentation and presentation of penetration testing results through detailed reports and presentations.

Module 1: Introduction to Ethical hacking and Footprinting	**No. of Hrs: 9**

Introduction: Importance of Security, Elements of Security, Phases of an Attack: Reconnaissance, Scanning, Gaining Access, Maintaining Access, Covering Tracks. Types of Hacker Attacks, Hacktivism, Ethical Hackers, Vulnerability Research, Conducting Ethical Hacking, Computer Crimes and Implications.

Introduction to Footprinting: Information-Gathering Methodology, Footprinting Tools, WHOIS Tools, DNS Information Tools, Network Range Locator Tools, Email spiders, Locating Network Activity, Meta Search Engines.

TextBook-1: Chapter 1, Chapter 2

Module 2: Scanning	**No. of Hrs: 9**

Introduction to Scanning: Scanning Definition, Objectives of Scanning, Scanning Methodology: Checking for live systems, check for open ports: Three-Way Handshake, TCP Communication Flags, Scanning Methods, War Dialing, Active Banner Grabbing Using Telnet. Fingerprint the operating system: Active stack fingerprinting, Passive stack fingerprinting, Scan for vulnerability: OpenVAS and Nikto, Probing the network: Preparing Proxies, Anonymizers. Surfing Anonymously: HTTP Tunneling, Spoofing IP Addresses, Detecting IP Spoofing, Scanning Countermeasures. Tools: Live System Scanning Tools, Port Scanning Tools

TextBook-1: Chapter 3

Module 3: Enumeration	**No. of Hrs: 8**

Introduction to Enumeration, Enumeration Techniques: Null Session Enumeration-Windows Session Establishment, Null Sessions, Null Session Vulnerabilities, Null Session Enumeration Techniques, Null Session Countermeasures. SNMP Enumeration-SNMP, SNMP Service Enumeration, SNMP Enumeration Countermeasures, SNMP UNIX Enumeration, SNMP UNIX Countermeasures. UNIX Enumeration- Showmount, Finger, Rpcinfo, LDAP Enumeration, NTP Enumeration, SMTP Enumeration, Web Enumeration, Web Application Directory Enumeration, Default Password Enumeration, Enumeration Procedure.

Tools: Null Session Tools-DumpSec, enum. User Account Tools-GetAcct. Null Session Countermeasure Tools-PsTools: PsExec, PsKill, PsList, SNMP Enumeration Tools-Snmputil, Solar Winds. LDAP Enumeration Tools- JXplorer, LdapMiner. SMTP Enumeration Tools-SMTPscan. General Enumeration Tools- NBTscan,Unicornscan.

TextBook-1: Chapter 4

Module 4: System Hacking	**No. of Hrs: 8**
Introduction to System Hacking: Cracking Passwords, Four Types of Password Attacks: Passive online attacks, Active online attack, offline attacks and Non Technical Attacks: Shoulder Surfing, Keyboard Sniffing, Social Engineering ,Password Guessing, Password Cracking Tools: LCP, ophcrack, Crack , Password Cracking Countermeasures, Escalating Privileges, Executing Applications, Keyloggers and Spyware, Keylogger and Spyware Countermeasures, Hiding Files, Rootkits, Rootkit Detection Tools, Steganography, Hiding the Data, Steganography Tools, Steganography Detection, Steganalysis Tools, Covering Tracks- Tools. **TextBook-1:**Chapter 5	
Module 5: Penetration Testing	**No. of Hrs: 8**
Introduction to Penetration Testing: Security Assessments, Types of Penetration Testing, Phases of Penetration Testing: Planning Phase: Risk Management, Pretest Dependencies, Enumerating Devices, Threats, Pre Attack Phase: Passive Reconnaissance, Active Reconnaissance, Network Mapping, Attack Phase, Postattack Phase, Tools: Nessus, SAINT, Metasploit, **TextBook-1:**Chapter 6	

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

1. **Explain** security fundamentals, ethical hacking, attack methods, and footprinting for ethical information gathering.
2. **Perform** network scanning, vulnerability assessment, and anonymization for risk identification and countermeasures.
3. **Analyze** the role of enumeration in identifying system vulnerabilities and apply appropriate mitigation techniques.
4. **Examine** system hacking techniques and implement corresponding defense mechanisms to secure systems.
5. **Analyze** penetration testing methodologies for effective vulnerability assessment and mitigation.

Textbooks:

1. The Experts: EC-Council, "**Ethical Hacking and Countermeasures Attack Phases**", Course Learning, Cengage Learning.

Reference Books:

1. James S. Tiller, "**The Ethical Hack: A Framework for Business Value Penetration Testing**", Auerbach Publications, CRC Press.
2. Michael Simpson, Kent Backman, James Corley, "**Hands-On Ethical Hacking and Network Defense**", Cengage Learning.
3. Gray Hat **Hacking - The Ethical Hackers Handbook**, Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams, 3rd Edition, Tata McGraw-Hill

Web links:

1. https://www.youtube.com/watch?v=fNzpcB7ODxQ
2. https://www.youtube.com/watch?v=uHU2uajL1EE
3. https://www.youtube.com/watch?v=K6V7fc5Hj2s
4. https://archive.nptel.ac.in/courses/106/105/106105217/

Introduction To Database Management System			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIOE312**	SEE Marks	**50**
Teaching Hours/Week(L:T:P)	**3:0:0**	Exam Hrs	**3**
Total Hours	**42**	Credits	**4**

Course Learning Objectives: This course is designed to

1. Impart foundational knowledge of database concepts.
2. Provide insights of the relational data model and data retrieval operations using relational algebra.
3. Emphasize the importance of normalization for effective data base design.
4. Familiarize SQL queries for various data retrieval scenarios.

Module1:Introduction to Databases	**No.ofHrs:7**

Introduction, Characteristics of database approach, Database Users, Advantages, Evolution of database applications, Disadvantages, Data Models, Schemas, Instances, Three schema architecture, data independence, Database languages, Interfaces, The Database System environment, Centralized and Client/Server architecture of DBMS.
TextBook1 Chapter1.1to1.9,Chapter2.1to2.5

Module2DataModels	**No.ofHrs:9**

Entity types, Entity Sets, structural constraints, Weak entity types, ER diagrams, Naming Conventions and Design Issues, **Relational Model:** Concepts, Constraints, relational database schemas, Update operations, Transactions, Dealing with constraint violations.
Relational Algebra: Unary Operations- SELECT and PROJECT, Set Theory - UNION, INTERSECTION and MINUS, Binary Operations - JOIN and DIVISION, Aggregate Functions, Examples Queries, Relational Database Design using ER-to-Relational mapping.
TextBook1 Chapter3.3to3.7,Chapter5.1to5.3,Chapter8.1to8.5,Chapter9.1

Module3Normalization	**No.ofHrs:8**

Database Design Theory and Normalization: Informal design guide lines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Inference Rules.
TextBook1 Chapter14.1to14.7,Chapter15.1

Module4QueryProcessing	**No.ofHrs:9**

SQL data types, DDL, DML and DCL, Specifying constraints in SQL, Basic retrieval queries in SQL, Nested and Correlated nested queries, Joined tables, outer joins, Aggregate functions, Assertions, Triggers , Views.
TextBook1 Chapter6.1to6.4,Chapter7.1to7.4

Module5TransactionManagement	**No.ofHrs:7**

Introduction to Transaction Processing, Transaction and System concepts, ACID properties, Characterizing schedules based on serializability, Transaction support in SQL. Two-Phase Locking Techniques, Recovery Concepts, Shadow Paging, ARIES Recovery Algorithm.
TextBook1 Chapter20.1,20.2.1,20.3,20.5.1,20.5.2,20.6,Chapter21.1.1,Chapter 22.1.3,22.4,22.5

Course Out comes: At the end of the course, the student will be able to

1. Describe relational data base concepts and transaction management.
2. Apply relational data model concepts to design a data base.
3. Apply normalization techniques to minimize data redundancy.
4. Apply relational data model operations for effective retrieval.

Textbook:

1. FundamentalsofDatabaseSystems,RamezElmasriandShamkantB.Navathe,7th Edition, Pearson, 2017.

Reference Books:

1. Data base management systems, Ramakrishnan, and Gehrke,3rdEdition,McGraw Hill, 2014.
2. SilberschatzKorthandSudharshan,DatabaseSystemConcepts,7thEdition,Mc-GrawHill, 2019.
3. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, ImplementationManagement,10thEdition,CengageLearning,2014.

Web links:

1. Introduction Database: https://www.youtube.com/watch?v=3EJlovevfcA
2. Database Languages: https://www.youtube.com/watch?v=9TwMRs3qTcU
3. ER Model: https://www.youtube.com/watch?v=ZWl0Xow304I
4. Relational Algebra: https://www.youtube.com/watch?v=4YilEjkNPrQ
5. ER Diagram to ER Model: https://www.youtube.com/watch?v=CZTkgMoqVss
6. Basic SQL Queries: https://www.youtube.com/watch?v=Hl4NZB1XR9c
7. Normal Forms: https://www.youtube.com/watch?v=EGEwkad_llA
8. TransactionandConcurrencyControl:https://www.youtube.com/watch?v=t5hsV9lC1rU

JAVA Programming			
Semester	**V**	CIE Marks	**50**
Course Code	**23CIOE313**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives:

1. Explain key constructs of the Java programming language.
2. Demonstrate object-oriented principles through practical applications.
3. Illustrate packages, multi-threading, and exception handling mechanisms

Module 1: History of Java, Introduction to Java Programming Language	**No. of Hrs: 10**

An Overview of Java: Object-Oriented Programming (OOP) –Two Paradigms: Structured and Object Oriented - Abstraction and OOP Principles: Polymorphism, Inheritance, and Encapsulation. Code Blocks, Lexical Elements - Whitespaces, Identifiers, Literals, Comments, and Separators. The Java Keywords, Data Types, Variables, and Arrays: The Primitive Types - Integers, Floating-Points, Characters and Booleans Variables, Type Conversion and Type Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables, Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, and The Ternary Operator. Operator Precedence, Using Parentheses, Control Statements: Selection Statements - if, if-then-else, nested if-then-else, and switch. Iteration Statements –loop variants: while, do-while, and for. Nested Loops, Jump Statements (break, continue, and return), Local Variable Type Inference
Text Book1: Chapter 2,3,4 and 5

Module 2: Classes and Methods	**No. of Hrs: 8**

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Methods, Constructors, "this" Keyword, and Garbage Collection, Methods and Classes: Overloading Methods, Argument Passing, Objects as Parameters, ReturningObjects, Recursion, Access Control, understanding static and final keywords, Nested and Inner Classes
Text Book 1: Chapter 6 and 7

Module 3: Inheritance and Interfaces	**No. of Hrs: 8**

Inheritance: Inheritance Basics, using super keyword, Types of Inheritance, Multilevel Hierarchy, When and how Constructors Are Executed, Method Overriding, Polymorphism, Dynamic Method Dispatch, Abstract Classes, Using final with Inheritance, The Object Class, **Interfaces:** Definition, Default Interface Methods, Use of static Methods in an Interface, Private Interface Methods
Text Book 1: Chapter 8

Module 4: Packages and Exceptions	**No. of Hrs: 8**

Packages: Packages, Packages and Member Access, Importing Packages
Exceptions: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions
Text Book 1: Chapter 9 and 10

Module 5: Multi-threading, Enumerations, Type Wrappers and Auto-boxing	**No. of Hrs: 8**

Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread,

Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Inter-thread Communication, Obtaining a Thread's State, Enumerations, Type Wrappers and **Autoboxing:** Enumerations - The values() and valueOf() Methods, Type Wrappers - Character, Boolean, The Numeric Type Wrappers Auto boxing / Unboxing Occurs in Expressions, Autoboxing/ Unboxing of Boolean, Character Values etc.
Text Book 1: Chapter 11 and 12

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

1. Illustrate proficiency in creating programs using branching and looping constructs
2. Develop a class that encompasses both data attributes and methods tailored to a specific context
3. Apply the principles of inheritance and interfaces to address practical challenges in real-world scenarios
4. Utilize the concept of packages and exception handling to tackle intricate problems
5. Develop programs by integrating concepts such as multithreading, autoboxing, and enumerations

Textbooks:

1. Herbert Schildt "**Java: The Complete Reference**", 12th Edition, McGraw-Hill, 2021

Reference Books:

1. E Balagurusamy, "**Programming with Java**", 6thEdition, by McGraw Hill Education, 2019
2. Bruce Eckel, "**Thinking in Java**", Fourth Edition, Prentice Hall, 2006

Web links:

1. Engineering Java Tutorial: https://www.geeksforgeeks.org/java/
2. Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
3. Java Tutorial: https://www.w3schools.com/java/
4. Java Tutorial: https://www.javatpoint.com/java-tutorial

Yoga-III			
Semester	**V**	CIE Marks	**100**
Course Code	**23NCMC321**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health
2. Promote the practice of mental hygiene
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents	**No. of Hrs: 13**

- Ashtanga Yoga
  1) Asana
  2) Pranayama
  3) Pratyahara
- Suryanamaskar13 count-3 rounds of practice
- Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas

a) Sitting
   1) Ardha Ushtrasana
   2) Vakrasana
   3) Yogamudra in Padmasana

b) Standing
   1) UrdhvaHastothanasana
   2) Hastapadasana
   3) ParivrittaTrikonasana
   4) Utkatasana

c) Prone line
   1) PadangushthaDhanurasana
   2) Poorna Bhujangasana

d) Supine line
   1) Sarvangasana
   2) Chakraasana
   3) Navasana/Noukasana
   4) Pavanamuktasana

- Revision of Kapalabhati practice 30 strokes/min3 rounds
- Meaning by name, technique, precautionary measures and benefits of each Pranayama
  1) Ujjayi
  2) Sheetali
  3) Sheektari

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

1. Describe the meaning, aim and objectives of Yoga
2. Perform Suryanamaskar and able to analyze its benefits
3. Exhibit the different Asanas by name, its importance, methods and benefits
4. Perform Kapalabhati
5. Perform the different types of Pranayama by its name, precautions, procedure and uses

Textbooks:

1. Ajitkumar," **Yoga Pravesha in Kannada**" 1st Edition, Raashtrot thaana Saahithya, 2017, ISBN-13: 978-8175310124
2. BKS Iyengar, "**Light on Yoga**", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly, "Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Books:

1. Yamini Muthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga ,https://youtu.be/KB-TYlgd1wE
2. Adiyoga, https://youtu.be/aa-TG0Wg1Ls

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Quiz	20
2	Practicaldemonstration	50
3	FinalReport	30
	Total	**100**

Physical Education-III			
Semester	V	CIE Marks	100
Course Code	23NCMC322	SEE Marks	-
Teaching Hrs/Week (L:T: P)	0:0:1	Exam Hrs	-
Total Hrs	13	Credits	-

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents:	**No. of Hrs:**
• Ethics in Sports & Moral Values in Sports and Games • Sports Training Methods and its Impacts: Continuous Training, Interval Training, Circuit Training, Weight Training • FITT Implementing FITT principles to design personalized fitness programs. (Lectures & Practical Sessions) • Specific Games (Students continue prior semester's game by practicing Intermediate Skills)	
Basket Ball Cross over dribble-Between-the-legs dribble-Bounce pass and no-look pass Shooting with form from mid-range-Defensive stance and footwork.	
Cricket Advanced batting shots (cover drive, square drive, pullshot)-Swing and seam bowling variations-Fielding positions and strategies –Game sense and awareness.	
Football Shielding the ball-Crossing the ball-Long passing an through balls-Tackling techniques (sliding & standing)-Shooting with power and accuracy-Playing different positions	
Hockey Stickh and lingintight spaces-Slap shot and sweep shot techniques-Passing with speed and accuracy-Dodging defenders-Defensive positioning and checking.	
Kabaddi Advanced raiding techniques (frogjump,jumpover)-Diverse raidingholds(frogkick,thighhold)-Anticipationandcounteringdefense-Effectiveraidingstrategies-Advancedteamdefenseformations.	
Karate Kihon(repetitionofbasictechniques)-Kata(formstopracticetechniqueandflow)-Combinationsofpunchesandkicks-Footworkandmovement-Basickumite(sparring)techniques.	
Table Tennis Looping technique (fore hand and back hand) –Top spinand backspin serves-Footworkforattackinganddefense-Blockingandcounteringtechniques-Matchstrategyandtactics.	
Throwball Longthrowsandbouncepasses-Fakepassesanddeceptionmoves-Dodgingtechniquestocreatespace-Defensivepositioningandguardingtechniques-Teamoffenseandsetplays	
Volleyball Attack, Block, Service, Upper Hand Pass and Lower hand Pass	

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

1. **Develop**strategiestopromoteethicalconductandapositivesportingculture
2. **Understand** the importance of ethics and moral values in sports and games
3. **Perform** in the selected sports or athletic events.

Textbooks:

1. Muller,J.P.,"**Health,ExerciseandFitness**",1st Edition,SportsPublication,2018
2. Uppal,A.K.,**"PhysicalFitness"**,FriendsPublicationNewDelhi,1992
3. RussellR.P.,**"Health&FitnessthroughPhysicalEducation:HumanKinematics",**HumanKineticsPublishers,1994

Reference Books:

1. Anaika,"**PlayFieldManual**",FriendsPublicationNewDelhi,2005
2. IAAF Manual
3. Pinto John & Roshan Kumar Shetty, "**Introduction to Physical Education**"

Web links:

1. https://www.youtube.com/watch?v=wvlztaJYKYI
2. https://www.youtube.com/playlist?list=PLHCNPOIaj2Wc8P5xAWq9g2DUrrbixoTOK
3. https://www.youtube.com/watch?v=K9X_wB1Yu84
4. https://www.youtube.com/watch?v=HEHggOOds1w&list=PLgVaM7Baa_8myp4njEDcoYyZkBq-542S5

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Participation of students	20
2	Quizzes-2,eachof15marks	30
3	Finalpresentation/Exhibition/ParticipationinCompetitions(Certificateofparticipationin National/International)	50
	Total	**100**

National Service Scheme(NSS) -III			
Semester	**V**	CIE Marks	**100**
Course Code	**23NCMC323**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of self less service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities
4. Impart knowledge in finding practical solutions to individual and community problems

Contents:	**No. of Hrs:**

Introduction:

- Promoting a healthy lifestyle among youth
- Nutrition education, stress management and mental health activities

Activities:

- Village awareness programs on women hygiene, various superstitious beliefs, avoiding self-medication, etc
- Helping local schools to achieve good results and enhance their enrolment in Higher/technical/ vocational education

Note:

- Students in individual or in a group should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department
- At the end of every semester, activity report should be submitted for evaluation

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

1. **Understand** the importance of nation building and individual contribution to the betterment of the society
2. **Discover** grassroots challenges of community and solve them by technological intervention
3. **Create** societal impact by upholding the value of one for all and all for one
4. **Maintain** discipline and team spirit

Textbooks:

1. "**National Service Scheme Manual**", Ministry of Youth Affairs & Sports, Government of India, 2022
2. "**Introduction Training Module for National Service Scheme (NSS) Program officers**", Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, 2017
3. Gurmeet Hans, "**Case material as Training Aid for field workers**" TISS, 1996

Reference Books:

1. Dr. G R Bannerjee, **Social service opportunities in Hospitals**, TISS, 2012
2. Ram Ahuja, **Social Problems in India**, Rawat publications, 3rd Edi ion, 2014

Web links:

1. History of NSS https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Participation of students	30
2	Individual contribution to success of the program	40
3	Report preparation	30
	Total	**100**

Arts -III			
Semester	**V**	CIE Marks	**100**
Course Code	**23NCMC324**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impartanunderstandingofthecreativeprocessfrominitialconcepttofinalexecution.
2. Createanddemonstrateproficiencyinachosenartsdisciplinethroughpracticalapplication
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events.

Contents:	**No. of Hrs: 13**
Note: Student will continue the arts form selected in previous semester.	
Performing Arts(Dance)	Orientation, Cinema Acting Basics, Facial Expression Exercises, Body Language, Camera Angles, Characterization demand Practice, Individual Presentations, Evaluation.
Arts & Crafts	Orientation, Craft Forms, Paper Craft, Mask Making, Model Making, Thermocol Art, Finger Puppet Making, Group Presentation, Evaluation.
Theatre	Orientation, Introduction to Theatre Sets and properties, Practical use of properties, Set Designing, Costume Design, Headgears and Masks, Theatre Makeup, Evaluation.

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

1. Capableofcreatingchoreographyanddeliveringliveperformancesforanaudience.
2. Employ acting techniques and use them to create a performance.
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance.
4. Acquire knowledge and comprehension of the roles and processes used in current theatre Arts practice.

Textbooks:

1. **Music in Theory and Practice** by Bruce Benward and Marilyn Sake, McGraw- Hill Education,2014
2. **Art Fundamentals: Theory and Practice** by Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, McGraw-HillEducation,2012
3. **The Viewpoints Book: A Practical Guide to Viewpoints and Composition** by Anne Bogart and Tina Landau, Theatre Communications Group,2004

Reference Books:

1. **Dance Composition: A practical guide to creative success in dance making**, Jacqueline M.Smith
2. **The Artist, handbook of method and materials** by Ralph Mayer
3. **Glimpses of Indian Music and Dance** by Dr. Arun Bangre.

Web links:

1. https://ccrtindia.gov.in/audio-visual-catalogue/

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Students Participation	20
2	Quizzes-2(eachof15marks)	30
3	Final presentation/Exhibition/Participation in Competitions	50
	Total	**100**

Business Intelligence			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPC306**	SEE Marks	**50**
Teaching Hrs/Week (L:T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Provide knowledge significance of Business Intelligence (BI) in data-driven decision making across organizations.
2. Impart an understanding of the evolution of BI and analytics, tracing the development from traditional Decision Support Systems to modern Prescriptive Analytics.
3. Familiarize students with the emerging trends, tools, and technologies in the field of Business Intelligence.

Module 1: Introduction	**No. of Hrs: 08**

Business Intelligence(BI) and Information Exploitation, Values of BI, Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS),A Framework for BI, Business Analytics Overview, Decision Support Systems: Capabilities and Classifications, Components of Decision Support Systems.

Text Book 1– Chapter 1, 2

Text Book 2 - Chapter 1: 1.5, 1.6, 1.7, 1.8 Chapter 2: 2.9,2.11

Module 2: Descriptive Analytics	**No. of Hrs: 08**

Data Warehousing: Definitions and Concepts, Data Warehousing Process Overview, Data Integration and Extraction, Transformation and Load (ETL) Processes, Data Representation and Analysis in Data Warehousing.

Business Reporting: Definitions and Concepts, Different types of Charts and Graphs, Emergence of Visual Data Analytics, Performance Measurement, Balanced Scorecards,Six Sigma Performance Metrics

Text Book 2- Chapter 3: 3.2, 3.4, 3.5, 3.6 Chapter: 4.2, 4.4, 4.5, 4.8, 4.9, 4.10

Module 3: Predictive Analytics	**No. of Hrs: 9**

Data Mining Basics. Data Mining Process, Neural Network Concepts and Implementation, Text Analytics & Mining Basics, Natural Language Processing, Text Mining Process, Sentiment Analysis Overview, Web Content and Web Structure Mining, Search Engines, Web Usage Mining, Web Analytics Maturity Model and Tools, Social Network Analysis.

Text Book 2–Chapter 5:5.4 Chapter 6:6,2,6.3,6.6

Chapter 7: 7.2,7.3, 7.5, 7.7, 7.9 Chapter 8: 8.3, 8.4,8.6,8.7,8.10

Module 4: Prescriptive Analytics	**No. of Hrs: 09**

Decision Support Systems Modeling, Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Multi-Goal Decision Strategy, Decision Analysis: Tables & Trees, Problem-Solving Search Methods, Genetic Algorithms Concepts, Agent-Based Modeling.

Chapters 9 :9.2.9.3,9.4,9.7,9.8 **Chapter 10:**10.2,10.3,10.7

Module 5: Expert Systems and Emerging Trends	**No. of Hrs: 08**

Basic Concepts of Expert Systems, Structure of Expert Systems, Development of Expert Systems, Knowledge Engineering, Problem Areas for Expert System, Development of Expert Systems, Knowledge Management Overview, Approaches to Knowledge Management, Knowledge Management System Cycle, Stream Analytics, Location Based Analytics for Organizations, Recommendation Engines, Cloud Computing and BI, Issues of Legality, Privacy and Ethics

Chapters 11:11.4,11.6,11.7,11.8,11.9**Chapter 12:**12.2,12.3,12.4**Chapter 13:**13.8
Chapter 14:14.3,14.4,14.6,14.7

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

1. **Explain** the business intelligence concepts, importance of analytics in decision making for BI applications and the emerging trends of BI.
2. **Discuss** the concepts and techniques for decision support systems, descriptive, predictive and prescriptive analytics for business intelligence.
3. **Illustrate** the process of descriptive analytics and data Visualization for making informed decisions.
4. **Apply** the techniques of Predictive and prescriptive analytics for BI applications.

Textbook:

1. David Loshin, "Business Intelligence – The Savvy Manager's Guide", Morgan Kaufmann Publishers, Copyright 2003, Elsevier
2. Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Supp rt", 10th Edition, Pearson Global Edition, 2013

Reference Books:

1. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017 by Edward Mize
2. Elizabeth Vitt, Michael Luckevich, Stacia Misner (2010). "Business Intelligence". O'Reilly Media, Inc.

Web links:

1. Business Intelligence & Analytics: https://onlinecourses.nptel.ac.in/noc24_cs65/preview
2. Business Analytics & Business Intelligence Full Course 2022 | Business Analysis | Simplilearn: https://www.youtube.com/watch?v=zbcCdoHeS4w

System Engineering			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPC307**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**2:0:0**	Exam Hrs	**2.5**
Total Hrs	**26**	Credits	**2**

Course Learning Objectives: This course is designed to

1. Impart knowledge on physical design principles, materials, sensor-actuator interfacing, communication protocols, and power management techniques.
2. Provide data modeling and storage methods for managing sensor and actuator data in physical systems.
3. Disseminate knowledge on user-centric interfaces and dashboards using UI/UX principles to meet business and system requirements.
4. Impart knowledge on scalability strategies and load balancing techniques to design efficient and scalable physical systems.

Module 1: Physical Design	**No. of Hrs: 6**

Understanding the basic principles and importance of physical design in engineering. Design Process: Steps involved in the physical design process. Materials and Components: Types of materials and components used in physical design.
Sensors, Actuators, Integrating Sensors and Actuators: Interfacing Sensors with Microcontrollers, Interfacing Actuators with Microcontrollers, Communication Protocols: I2C, SPI, UART, and CAN for sensor and actuator integration. Power Management: Power requirements and management for sensors and actuators. Case Studies: Use of sensors and actuators in automation.

Module 2: Data Model Design	**No. of Hrs: 5**

Data Store Concepts: Relational databases, NoSQL databases, file-based storage. Storage Technologies: SSDs, HDDs, cloud storage, in-memory databases. Data Store Selection, Design of EER Models. Data Requirements in Physical Systems, Sensor Data Management: Designing data models for sensor data storage and retrieval. Actuator Control Data: Modeling data for actuator control and feedback. Real-time Data Processing: Techniques for handling real-time data in physical systems. Case study (Example: Design EER Model for a Smart Home System).

Module 3: Interface design	**No. of Hrs: 5**

Overview of UI/UX design: definition and importance, Hardware User interface(HUI), roles and responsibilities in UI/UX, Importance of UI/UX in system design, integration of UI/UX with system architecture. Introduction to dash board design: types of dash boards (operational, analytical, and strategic), effective dashboard design. Designing for business values: identifying business KPIs-custom dash board design for business goals, creating value driven dash board, measuring impact of dashboard design.

Module 4: Scalability	**No. of Hrs: 5**

Introduction to scalability, types of scalability-vertical and horizontal. Principle of scalable system design: design principles, architectural pattern. Load balancing: types of load balancing. Database scalability: scaling databases, sharding, and replication. Distributed systems: CAP theorem, Monitoring and performance tuning.

Module 5: Case studies	**No. of Hrs: 5**

Case studies for system design such as Smart city traffic management system-real time data collection and processing, scalability, data storage and management, analytics and reporting and

user interface. Netflix- Global scale streaming. Amazon- scalable E-commerce platform. Scalable environment monitoring system, Scalable health care monitoring system, Scalable agricultural monitoring systems etc.
Course Outcomes: At the end of the course, the student will be able to 1. Explain physical design principles, materials, sensor-actuator integration, communication protocols, and power management techniques 2. Apply data modeling and storage techniques suitable for physical systems and sensor-actuator integration 3. Apply UI/UX and dashboard design principles to build interfaces for business and system needs. 4. Apply scalability and load balancing concepts to design scalable physical systems.
Reference Books: 1. Raj Kamal, Embedded Systems: A Comprehensive Guide to Embedded Systems and Computer Engineering" , 4th Edition, 2020. 2. Martin Kleppmann ,Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, O'REIlY publication,2017 3. Rex Hartson, Pardha S. Pyla, The UX Book: Agile UX Design for a Quality User Experience, 2019.
Web links:

Artificial Intelligence			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPC308**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:0**	Exam Hrs	**2.5**
Total Hrs	**26**	Credits	**02**

Course Learning Objectives: This course is designed to

1. Provide a fundamental perspective of AI and its foundations.
2. Familiarize with basic principles of AI toward problem solving
3. Impart knowledge on various approaches of inference, perception, knowledge representation, and learning.

Module 1: Introduction to AI	**No. of Hrs: 5**

Introduction to AI: history, foundation and sub area of AI, applications, current trend and development of AI, Problem solving: state space search and control strategies.
Text book 1 : Chapter 1: 1.1, 1,2, 1.4, 1.5, 1.6, 1.9, Chapter 2: 2.1,2,2, 2.3, 2.4.1,2.4.2, 2.4.3, 2.5.1,2.5.2,2.5.3

Module 2: Problem reduction and Game playing	**No. of Hrs: 5**

Problem reduction and Game playing : Problem reduction, game playing, Bounded look-ahead strategy, alpha-beta pruning
Text book1 : chapter 3 : 3.1 to 3.5

Module 3: Logic concepts and logic Programming	**No. of Hrs: 6**

Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic
Text book1 : chapter 4 : 4.1,4.2,4.3,4.6, 4.7, 4.8

Module 4: Advanced problem solving paradigm	**No. of Hrs: 5**

Advanced problem solving paradigm: Planning: types of planning system, block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis,
Text book 1 : Chapter 6.1 to 6.6

Module 5: Knowledge Representation	**No. of Hrs: 5**

Knowledge Representation: Expert system Approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, Knowledge representation using Frames.
Text book 1 : Chapter 7: 7.1 to 7.5

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

1. Describe basic concepts of Artificial Intelligence
2. Apply problem reduction approaches for implementing AI solutions for basic generic problems
3. Illustrate the logical reasoning & problem solving methods for AI ag nts programs
4. Demonstrates the workflow of knowledge representation architecture of artificial intelligence agents

Textbooks:

1. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014.

Reference Books:

1. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. Staurt Russel, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3rd Edition, 2009
4. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
1.

Web links:

1. Artificial Intelligence: Knowledge Representation And Reasoning: https://nptel.ac.in/courses/106106140
2. Course materials : Artificial Intelligence: A Modern Approach, 4th US ed https://aima.cs.berkeley.edu/

PROJECT PHASE – I			
Semester	**VI**	CIE Marks	**100**
Course Code	**23CISE309**	Credits	**03**
Hours/Week (L: T:P)	**0:0:6**	Mode	**Experiential**

Objective:

1. To develop the students' ability to independently or collaboratively identify a problem, review literature, define objectives, and propose a preliminary methodology for solving an engineering problem, which will be realized in Project Phase – II.
2. The course also aims to develop leadership and interpersonal communication skills within team members.

General Guidelines:

1. A project guide (faculty member) will be allocated by the department
2. The HoD shall appoint a project coordinator who will take the responsibility of monitoring all the activities related to the project execution.
3. The HoD shall constitute project evaluation/review committee(s) & the composition shall be as follows:
    a. HOD or one of the HODs in case of an interdisciplinary p orject, shall be the Chairman of the committee
    b. Project Coordinator shall be member -Convener
    c. Project guide shall be the member
    d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)
4. Each project team shall consist of 2 to 4 students from the same department or different departments.
5. Interdisciplinary projects may be allowed with prior approval from the concerned HODs only.
6. Project teams must arrive at problem statementsthat address either real-world challenges or research-related issues relevant to their domainof study. Each team must formulate an appropriate project title in consultation with their project guide.
7. Each project team shall maintain a project dairy and record their project progress at regular interval of time. This shall carry signature of the students and the project guide.
8. There is no Semester End Examination (SEE) for this course and evaluation is based entirely on Continuous Internal Evaluation (CIE)

9. Marks may be equally or proportionally distributed among team members based on contribution assessed by the guide and committee.
10. A student shall obtain minimum of 40% of the total marks to pass t is course
11. Plagiarism, data fabrication, or copying of work will result in str ngent disciplinary action and /or penalties. (Note: Any disciplinary actions or penal ies will be as per institutional policy.)

Deliverables:

1. Comprehensive Project Report comprising of:
    - Abstract
    - Introduction
    - Literature Survey
    - Problem Definition
    - Proposed Methodology
    - Design
    - Summary and Work Plan for Phase-II
    - References
    - Appendices

The project report shall be prepared in the prescribed format provided by the institute.

2. A plagiarism report shall be obtained from the Department of Library. Acceptable similarity threshold is generally below 20%, and hence, the plagiarized content shall not exceed 20%.Similarity above 20% will require resubmission after proper revisions

Review and Evaluation:

1. There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review - 1	
Topic approval, Problem Definition & Objectives	20 Marks
Literature Review	10 Marks
Innovation/Novelty	10 Marks
Total	**40 Marks**

Review - 2	
Methodology & Design	15 Marks
Report Quality & Formatting	15 Marks
Total	**30 Marks**

Presentation	
Presentation	20 Marks
Team work	10 Marks
Total	**30 Marks**
Grand Total	**100 Marks**

2. First review shall be conducted after one month from the start of the semester
3. Further, every department shall develop rubrics to assess performance of the students based on the above given parameters

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

CO1. Identify an engineering or research problem through a thorough review of relevant literature.

CO2. Design an appropriate solution or methodology to address the identified problem.

CO3. Prepare a comprehensive project report.

CO4. Effectively present each component of the project report to a knowledgeable audience.

CO5. Collaborate and contribute effectively as a team member, recognizing the dynamics of both individual and group work.

	Business Intelligence Laboratory Semester **VI** CIE		
Marks			**50**
Course Code	**23CIPC310**	SEE Marks	**50**
Teaching Hrs/Week (L:T:P)	**0:1:3**	Exam Hrs	**03**
Total Hrs	**13+39**	Credits	**02**

Course Learning Objectives: This course is designed to

1) Provide insights on implementing Decision Support Systems (DSS) using descriptive, predictive, and prescriptive analytics to enhance decision-making for business solutions.
2) Impart knowledge on applying clustering, optimization, and recommendation techniques to develop data-driven solutions that support decision-making.
3) Provide hands-on experience in building efficient data-driven solutions for feature selection, cloud-based analytics, and real-time data stream processing under limited resources.

Module 1: Introduction to Business Intelligence Tools	No. of Hrs:13

Data retrieval and visualization using MySQL and Pandas, Exploratory Data Analysis (EDA) in Python, ETL (Extraction, Transformation, and Load) Processes: Data extraction using MySQL, Data transformation using Python (Pandas, NumPy), Loading processed data into a warehouse.
Web scraping using BeautifulSoup and Scrapy, Sentiment Classification Using VADER, TextBlob, Data Collection from Social Media, Twitter API, IMDb, YouTube comments API, Recommendation System Approaches: Collaborative Filtering vs. Content-Based Filtering, Building recommendation models with Scikit-learn and Surprise library, Firebase Firestore and Google Colab, BI Dashboard Creation, Google Data Studio, Hosting dashboards using GitHub
Pages and Google Drive.

1) A retail company wants to analyze customer purchase trends, predict future sales, and provide recommendations for increasing customer engagement and revenue. The company needs a Decision Support System (DSS) that can:
   - Summarize customer purchase data (Descriptive Analytics)
   - Predict future sales trends based on historical patterns (Predictive Analytics)
   - Recommend business strategies for customer retention and revenue growth (Prescriptive Analytics)

Hint :Use MySQL and Python

2) Design and implement a data warehouse for a retail business, apply ETL (Extraction, Transformation, and Load) processes, perform OLAP operations, and generate business performance reports using Python and MySQL.

3) A movie production company wants to understand how audiences feel about a new movie based on social media discussions and reviews. To achieve this, the company aims to:
- Collect social media posts and reviews related to the movie.
- Analyze sentiment to determine public opinion.
- Identify trending hashtags and discussions around the movie.
- Visualize insights using graphs and word clouds.

Hint :Use Twitter API, IMDb, Rotten Tomatoes, or YouTube comments API to collect movie reviews and discussions. Clean the text by removing special characters, stopwords, and emojis.

4) A healthcare organization wants to analyze online patient feedback, medical articles, and web traffic to improve services and provide better patient care. To achieve this, the organization aims to:

- Extract health-related web content from medical websites and forums.
- Analyze web structure to understand link connections in healthcare networks.
- Study web usage patterns to track patient searches and appointment trends.
- Visualize insights using dashboards and graphs for decision-making

Hint: Scrape health-related websites (e.g., WHO, medical forums, hospital websites) using BeautifulSoup/Scrapy.

5) Develop an AI-powered system that automates resume screening using NLP to extract attributes like skills, experience, and qualifications. Apply rule-based filters for initial selection and use a neural network model trained on labeled resumes to classify candidates into shortlisted, rejected, or under review.

6) Implement a Kohonen Self-Organizing Map (SOM) to perform unsupervised clustering on a high-dimensional synthetic dataset. The objective is to:

- **Reduce the dimensionality** of the dataset while preserving the topological relationships between the data points.
- **Discover natural clusters** within the data without relying on predefined labels.
- **Visualize the clustering results** by mapping similar data points to adjacent neurons in the 2D SOM grid.

Dataset Generation:

Generate a synthetic dataset with the following characteristics:

- **Number of samples:** 1000
- **Number of features:** 5 (high-dimensional space)
- **Number of clusters:** 3

7) Design and implement a Python-based Decision Support System (DSS) that uses a **Hopfield Neural Network** to model and optimize a ₹60,000 monthly budget while satisfying multiple financial goals. The system should adopt a **multi-goal decision strategy** to handle constraints and provide intelligent recommendations.

Financial Goals:

Save ≥ 20% of income
Spend ≤ 30% on rent/utilities
Allocate ≥ ₹5,000 to health/wellness
Spend ≥ ₹3,000 on entertainment

Expense Categories:

Rent & Utilities, Groceries, Transportation, Health & Wellness, Entertainment, Savings, Miscellaneous

Task	Description
Model Budget Plan	- Define variables/functions for each category.
	- Validate that allocations meet financial goals.
	- Use a Hopfield Network energy function to model constraints and minimize violations.
What-If Analysis	- Generate multiple budget scenarios using random or guided simulations.
	- Visualize valid outcomes using bar charts and pie charts with matplotlib or seaborn.
Sensitivity Analysis	- Analyze how variations in Groceries and Transportation affect Savings.
	- Visualize impact using line/scatter plots to reveal sensitivity and thresholds.
Goal-Seeking	- Apply Hopfield-inspired optimization to maximize Entertainment spending.
	- Ensure that Savings ≥ 20% and all other constraints are still satisfied.
Recommendations	- Suggest an optimized budget configuration that meets all goals.
	- Use visual summaries (e.g., dashboards, charts) to present a clear financial plan.

8) An e-commerce platform wants to enhance customer experience by providing personalized product recommendations. The system should:

- Analyze past purchase and browsing history to understand customer preferences.
- Implement recommendation models (collaborative filtering or content-based filtering).
- Provide relevant product suggestions to increase customer engagement and sales.

9) Given a dataset with multiple features, implement a **Genetic Algorithm (GA)** to select the most relevant features for a classification model (e.g., Decision Tree, SVM) that maximizes model accuracy based on the tasks given below.

1. Represent each feature subset as a **chromosome** (binary vector where 1 indicates inclusion and 0 indicates exclusion of features).
2. Define a **fitness function** based on the **model accuracy** (higher accuracy means higher fitness).
3. Apply **selection**, **crossover**, and **mutation** to evolve the feature subsets.
4. Train the classification model using the selected features and evaluate its **accuracy**.
5. Output the **best feature subset** and the **corresponding accuracy**.
6. Visualize the **accuracy evolution** across generations.

10) A small business seeks to leverage cloud-based Business Intelligence (BI) solutions to analyze sales trends and customer behaviour without incurring costs for paid tools. The objectives include:

Utilizing a free cloud database, such as Firebase Firestore, for storing and managing data.

- Performing data analytics and processing through free tools like Google Colab.
- Building an interactive BI dashboard using Google Data Studio for visualizing insights.
- Hosting data and dashboards using platforms like Google Drive and GitHub Pages.

11) Simulate a real-time **data stream** (e.g., sensor readings or network traffic values) and develop a simple **stream mining** model that continuously analyzes incoming data to detect significant **patterns** or **anomalies**.

Hint: Simulating a Data Stream, **Anomaly Injection:** Add occasional spikes to simulate unusual data.

12) A leading medical college is expanding its campus facilities. The task is to analyze potential new site locations using spatial and demographic data.

Given:

Existing campus locations and enrolment data.

A list of potential new site coordinates.

Demographic data for each location (population, income, and age distribution).

Based on the above information implement the following to do the following:

- Identify new sites **at least 100 km away** from existing campuses.
- Match demographic profiles of potential locations with those of high-performing campuses.
- Recommend the best locations for new campus expansion.

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

1. Implement techniques for Decision Support Systems using descriptive, predictive, and prescriptive analytics to support business intelligence and informed decision-making.
2. Develop data-driven solutions using clustering, optimization, and recommendation techniques to support decision-making and improve user experience.
3. Build smart data-driven solutions for feature selection, cloud analytics, and real-time data processing.

Text Books:

1. Learning MySQL by M.M. Tahaghoghi, Hugh Williams Publisher: O'Reilly Media , 2020
2. *Python for Data Analysis (3rd Edition) by Wes McKinney.* O'Reilly Media
3. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit,1st Edition, 2009 by Steven Bird, Ewan Klein, and Edward Loper,O'Reilly Media.
4. Hands-On Recommendation Systems with Python (1st Edition, 2018) by Rounak Banik, published by Packt Publishing.
5. https://pytorch.org/tutorials/beginner/colab.html
6. https://firebase.google.com/docs/firestore
7. *Google Data Studio for Beginners*by Grant Kemp& Gerry White,Apree Publisher,2021 edition.

Cryptography & Network Security			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPE321**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Provide basics of Cryptography concepts, Security and its principle
2. Impart knowledge on public and private key cryptography
3. Impart knowledge on key distribution scenario and certification
4. Impart knowledge on the approaches and techniques to build protection mechanism to secure computer networks

Module 1: Encryption Techniques — **No. of Hrs: 8**

A model for Network Security, Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography. Block Ciphers an Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.

Text Book 1: Chapter 1: 1.8 Chapter 3: 3.1, 3.2, 3.5 Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5

Module 2: Public key cryptography — **No. of Hrs: 9**

Pseudorandom number Generators: Linear Congruential Generators, Blum Blum Shub Generator. Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, Public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA. Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography

Text Book 1: Chapter 8: 8.2 Chapter 9: 9.1, 9.2 Chapter 10: 10.1, 10.4

Module 3: Hash functions, Key management and distributions — **No. of Hrs: 8**

Applications of Cryptographic Hash functions, Two simple Hash functions, Key management and distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key Infrastructures

Text Book 1: Chapter 11: 11.1, 11.2 Chapter 14: 14.1, 14.2, 14.3, 14.4, 14.5

Module 4: User Authentication and E-mail security — **No. of Hrs: 9**

User Authentication: Remote user authentication principles, Kerberos, Remote user authentication using asymmetric encryption. Web security consideration, Transport layer security. Email Threats and comprehensive email security, S/MIME, Pretty Good Privacy.

Text Book 1: Chapter 15: 15.1, 15.3, 15.4 Chapter 17: 17.1, 17.2 Chapter 19: 19.3, 19.4, 19.5

Module 5: IP Security — **No. of Hrs: 8**

IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange.

Text Book 1: Chapter 20: 20.1, 20.2, 20.3, 20.4, 20.5

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

1. Explain the basic concepts of Cryptography and Security aspects
2. Apply different Cryptographic Algorithms for different applications
3. Describe methods for authentication and access control.
4. Describe key management, key distribution and Certificates for network security.
5. Describe Electronic mail and IP Security.

Text Book:

1. William stallings, "Cryptography and Network Security", Pearson Publication, Seventh Edition.

Reference Books:

1. Keith M Martin, "Everyday Cryptography", Oxford University Press
2. V.K Pachghare,"Cryptography and Network Security", PHI, 2nd Edition

Web links:

1. Full NPTEL course: https://archive.nptel.ac.in/courses/106/105/106105_31/
2. Full NPTEL course: https://nptel.ac.in/courses/106105162

Social Network Analysis			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPE322**	SEE Marks	**50**
Teaching Hrs/Week (L:T: P)	**2:0:2**	Exam Hrs	**03**

Course Learning Objectives: This course is designed to

- **Familiarize** students with the fundamental concepts and metrics of Social Network Analysis.
- **Provide** an understanding of various network structures, growth models, and the principles governing network formation and evolution.
- **Impart** knowledge on advanced topics such as community detection, link prediction, network dynamics, and human behavioral patterns in social networks.
- **Provide** skills to visualize and interpret social network data across a range of real-world applications using appropriate tools and techniques

Module 1: INTRODUCTION — **No. of Hrs: 6+4**

INTRODUCTION: Preliminaries, Applications, Levels of SNA, Network Basics.
Graph theory: General definition of a graph, Types of graphs, Vertex and edge properties, Representations of graphs. Creating graphs in R
Text book 1: Ch 1:1.1-1.5, Ch 2:2.1 to 2.2
Textbook 2: Ch 1: 1.1 to 1.3
Lab Components:

1. **R Programming :** Introduction, Data in R, Data Frame, Functions & Packages, Error handling, Randomization in R.
2. Load the pizza data set from the onadata package or load it as a dataframe from the internet. This data set represents requests made by Reddit users on a thread called Random Acts of Pizza or ROAP, and is part of a larger data set used for research purposes. The requester column represents users who made requests for pizza, and the responder column represents users who read the request and responded to the request by giving pizza. Other columns represent the request ID and data on the requester at the time the request was made.
   a) Use an appropriate method to create a graph object using the requester and responder columns in this data set.
   b) Use the information contained in the graph object to determine how many pizza requests were fulfilled.
   c) Determine using the information in the graph whether anyone fulfilled more than one pizza request.
   d) Using an appropriate method, add the other columns in the pizza data set as edge properties.
   e) Use the edge properties of your graph object to determine which request ID had the largest number of requester votes.
   f) Use the edge properties of your graph object to determine which request ID had the largest number of requester subreddits.

Module 2: Graph Visualization — **No. of Hrs: 5+4**

Visualizing Graphs: Visualizing graphs in R, Native plotting in igraph, Graph layouts, Static

plotting with ggraph, Interactive graph visualization using vis Network and networkD3, Visualizing graphs in Python, Static plotting using networkx and matplotlib, Interactive visualization using networkx and pyvis.

Restructuring Data for Use in Graphs: Transforming data in rectangular tables for use in graphs, and Transforming data from documents for use in graphs.

Textbook 2: Ch2,Ch3

Lab Components:

Load the park_reviews data set from the onadata package or download it from the internet43. This data contains the reviews of a collection of Yelp users on dog parks in the Phoenix, Arizona area.

1. Create an edgelist and vertex set that allows you to build a graph showing both the parks and the users as entity types. Include the stars rating as an edge property and ensure that entity types are distinguishable in your data.
2. Use your edgelist and vertex set to create a graph object that has edge and vertex properties.
3. Visualize your graph in a way that differentiates between users and parks. Use your visualization to point out users that have reviewed numerous dog parks.
4. Generate a subgraph consisting only of edges where the stars rating was 5. Repeat your visualization for this subgraph. Use it to identify a frequently 5-star rated park. Has any user reviewed more than one park as 5-star rated?

Module 3: Theory of graph traversal	**No. of Hrs: 5+4**

Paths and Distance: Theory of graph traversal, paths and distance, Shortest path algorithms. Graph diameter and density, calculating paths, distance, diameter and density, Facilitating introductions in a workplace, Finding distant colleagues in a workplace

Textbook 2: Ch4, Ch5

Lab Components:

load the friends_tvedgelist data set from the onadata package or download it from the internet. This is a full network of all characters appearing in every season of the *Friends* TV series based on characters speaking in the same scene together. Each edge has a weight according to the number of scenes those characters both spoke in together, but ignore this for this set of exercises and simply create an unweighted, undirected graph from this edgelist.

1. Check whether the *Friends* network is connected and calculate the diameter of the network. Find a path with length equal to the diameter.
2. Calculate the density of the network. Create a subgraph consisting of the six main characters: Monica, Chandler, Phoebe, Ross, Rachel and Joey. Calculate the density of this subgraph. What term would you use to describe this subgraph.

Module 4: Components, Communities and Cliques	**No. of Hrs: 5+4**

Vertex Importance and Centrality, Vertex centrality measures in graphs, centrality in graph visualizations, Connected components of graphs, Vertex clustering and community detection , Partitioning and community detection, Finding components, communities and cliques Examples of uses Detecting communities and cliques among Facebook friends, Detecting politically aligned communities on Twitter.

Textbook 2: Ch6, Ch7

Lab Components:

Given the email communication data of a large research institution, which includes an edge list (email_edgelist) representing email exchanges and a vertex list (email_vertices) containing details about each individual, including their department. Perform the following

tasks using R:

1. Create an undirected graph from the given data.
2. Identify the connected components of the network and extract the largest connected component.
3. Apply the Louvain community detection algorithm to the largest connected component and calculate the modularity of the detected communities.
4. Compare the community structure obtained from the Louvain algorithm with the ground truth department structure. Visualize the graph color-coded by both the Louvain community and the department.
5. Find the largest clique in the graph and visualize it. What do the largest cliques represent in the context of the network?
6. Create a heatmap showing the distribution of departments across the detected communities.

Module 5: Graph database	**No. of Hrs: 5+4**

Assortativity and Similarity: Assortativity in networks, Graph similarity, Calculating assortativity and similarity in Python.
Graphs as Databases: Graph database technology, Example: how to work with a Neo4J graph database, Using the browser interface, Working with Neo4J using R and Python.
Textbook 2: Ch8, Ch9
Lab Components:
1. Design and implement a **graph database** using **Neo4j** to represent an organizational network. The graph should include:

- Nodes for at least three employees and one project.
- Relationships such as MANAGES and WORKS_ON.

Perform the following tasks:

1. **Create the graph** using the Neo4j browser interface and Cypher queries.
2. **Query the graph** to:
   - Retrieve all employees and their roles.
   - List employees working on a specific project.
   - Display manager-subordinate relationships.
3. **Access the graph data** programmatically:
   - Using **R** and the neo4r package.
   - Using **Python** and the neo4j driver.
4. **Discuss** how graph database systems like Neo4j can be used for persistent graph data storage and analytics in organizations.

Course Outcomes: At the end of the course, students will be able to:

1. **Describe** the fundamental concepts of graph theory and explain how they are used to model real-world social networks.
2. **Illustrate** complex networks through appropriate static and interactive graph plotting techniques for effective visualization and analysis.
3. **Apply** graph traversal techniques to evaluate network connectivity and compute key metrics such as shortest paths, diameter, and density in real-world social datasets.
4. **Apply** clustering algorithms and centrality measures to detect communities, cliques, and influential nodes, and interpret their relevance in real-world group structures.
5. **Design** and **query** graph databases using Neo4j, and **implement** programmatic access to integrate and retrieve network data

TEXT BOOK:

1. Social Network Analysis, Tanmoy Chakraborty, Wiley, 2021
2. Handbook of Graphs and Networks in People AnalyticsWith Examples in R and Python

REFERENCE BOOKS:

1. Network Science, Albert-Lazzlo Barabasi
2. Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faus

NPTEL REFERENCE:

1. Social Network Analysis - Course

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=IiUDKDxScxI
2. http://www.nitttrc.edu.in/nptel/courses/video/106106146/L21.html
3. https://www.youtube.com/watch?v=DTxE9KV3YrE
4. https://www.youtube.com/watch?v=MQsTxRMy3Xg
5. https://www.youtube.com/watch?v=BQWoMRS5CGA
6. https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Big Data Analytics			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIPE323**	SEE Marks	**50**
Teaching Hrs/Week (L:T:P)	**2:0:2**	Exam Hrs	**03**
Total Hrs	**50 hrs (Total theory – 26 hrs Total practical – 24 hrs)**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Provide knowledge of the core concepts of Big Data and Analytics.
2. Impart knowledge ofBig DataProcessing frameworks and the Programming Model.
3. Familiarize tools, technologies and NoSQL datastores for performing Big Data analytics.

Module 1: Big Data, Hadoop and HDFS — **No. of Hrs: 6+4**

Introduction, Big Data: Definitions, Characteristics, Types, Classification, Applications of Big Data Analytics, Apache Hadoop Design Principles,The Apache Hadoop Project Ecosystem, Hadoop Distributed File System (HDFS): Design Features, Components, Block Replication, Safe Mode, Rack Awareness, NameNode High Availability, Namespace Federation, Checkpoints and Backups, Snapshots and NFS Gateway

Laboratory Components:

1. Install Hadoop in pseudo-distributed mode and run services.
2. Implement the following HDFS operations:
   a) Make a directory
   b) Copya dataset file in the created directory
   c) Show contents of the file
   d) Get file from HDFS
   e) Remove the file and
   f) Remove a directory

Text Book 1 - Chapter 1:1.2 (1.2.1 to1.2.4)
Text Book 2 – Chapter 1: 1.4.1 to 1.4.3 (for Applications of Big Data Analytics)
Text Book 3 – Chapter 1: 1.6.1 and 1.8 Chapter 3: 3.1, 3.2, 3.3(for HDFS User Commands)

Module 2: MapReduce, YARN and Sqoop — **No. of Hrs: 5+4**

Hadoop MapReduce Framework: The MapReduce Model, MapReduce Parallel Data Flow, Fault Tolerance and Speculative Execution, Speculative Execution, Apache Hadoop MapReduce Example, MapReduce Advantages, Apache Hadoop V1 MapReduce Operation, Moving Beyond MapReduce with Hadoop V2, Hadoop V2 YARN Operation Design, RDBMS Data acquisition: Apache Sqoop Import and Export Methods, version changes, Sqoop example walkthrough,

Laboratory Components:

3. Develop a MapReduce program to find the top-N words in an input text file.
4. Implement Sqoop operations to perform the following:
   a. Import data stored in a relational database into HDFS, work with jobs and export data from HDFS to a relational database

Text Book 3 – Chapter 1: 1.6.2, 1.6.3, 1.6.4, 1.7, 1.7.1 Chapter 7: 7.3

Text Book 2 –Chapter7: 7.2.3

Module 3: NoSQL	**No. of Hrs: 5+4**

NoSQL Data Store, Schema-less Models, Increasing Flexibility for Data Manipulation. NoSQL Data Architecture Patterns: Key-Value Store, Document Store, Column Family Databases: MongoDB Database, HBase Database

Laboratory Components:

5. Build an analytics system using MongoDB that provides meaningful insights into movies, user comments, and viewer engagement using the publicly available sample_mflix dataset.

Tasks to Solve:

a) List the top 5 most commented movies.
b) Find the top 10 movies by average rating.
c) Display the number of comments posted each year.
d) Find all movies in the 'Action' genre released after 2010.
e) Identify users who have posted more than 50 comments.

6. Design an HBase-based storage system to store and query user ratings of books by performing the following:
   a) Create HBase table using public dataset: BX-Book-Ratings.csv
   b) Insert sample records into the table
   c) Run basic queries as:
      - Get rating given by a user for a book
      - Scan all ratings by a specific user
      - Scan 10 entries of book ratings

Text Book 1 – Chapter 3: 3.2, 3.3 (3.3.1, 3.3.2), 3.6

Text Book 2 – Chapter 4: 4.3

Module 4: HIVE and Pig	**No. of Hrs: 5+4**

HIVE characteristics and limitations, HIVE Architecture, Comparison with RDBMS, HIVE Data Model, HIVE Integration and workflow steps, HIVEQL

Apache Pig - Grunt Shell, Pig Latin Data Model, Pig Latin and Developing Pig Latin Scripts

Laboratory Components:

7. Design a HIVE-based solution to store and analyze air quality data from around the world by performing the following:
   a) Create HIVE Table as per the dataset: global_air_quality.csv
   b) Load csv dataset into HIVE
   c) Execute HIVE queries for the following:
      - View sample data
      - Find average PM2.5 levels in India
      - Count number of pollution readings per country
8. Implement a Pig program for finding the most common word from the news stored in a csv file.

Text Book 1 - Chapter 4: 4.4 (4.4.1, 4.4.5), 4.5, 4.6 (4.6.1, 4.6.3, 4.6.4)
Text Book 2 – Chapter 7: Box 7.11

Module 5: Apache Spark	**No. of Hrs: 5+4**

ApacheSpark, Spark Operations, Spark Streaming, Spark SQL

Laboratory Components:

9. Develop Apache Spark Python program for computing word count from an input text file.
10. Implement Interactive querying of weather data by working with RDDs and Spark SQL.

Text Book 2 - Chapter 7: 7.6, 7.6.1 and Box 7.19 Chapter 8: 8.3 and 8.3.1
Chapter 9: 9.1 and 9.1.1

Each student needs to do a **mini project of 04 hours'** duration. The objective of this mini project is to analyze a large dataset to extract meaningful insights.

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

1. **Discuss** the fundamental concepts of Big Data Analytics and its real-world applications.
2. **Explain** the Big Data processing frameworks, NoSQL data stores and the Hadoop Ecosystem tools.
3. **Illustrate** the working of MapReduce, Hadoop Ecosystem tools and Apache Spark for Big Data Analytics.
4. **Apply** the concepts of NoSQL datastores to show the handling of data for real world applications.

Text Books:

1. Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning", McGraw Hill Publication, 2019.
2. Arshdeep Bahga and Vijay Madisetti, "Big Data Analytics A Hands-On Approach", 2018.
3. Douglas Eadline, "Hadoop® 2Quick-Start Guide – Learnthe Essentials of BigData Computing in the ApacheHadoop® 2 Ecosystem", Addison Wesley, 2016.

Reference Books:

1. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012
2. Tom White ,"Hadoop: TheDefinitiveGuide"4th Edition, O'reilly Media,2015.
3. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers &Techniques, Pearson India Education Service Pvt. Ltd., 1stEdition, 2016
4. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition

Web links:

1. Big Data Computing: https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2. Big Data Analytics: https://www.coursera.org/articles/big-data-analytics
3. Big Data Tutorial: https://data-flair.training/blogs/big-data-tutorials-home/
4. Sqoop Data Transfer Tool: https://www.tutorialspoint.com/sqoop/sqoop_job.htm

Digital Forensics			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIOE321**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**3**
Total Hrs	**42**	Credits	**3**

Course Learning Objectives: This course is designed to

1. Gain insights about the basic principles, methodologies, and tools used in computer forensics to investigate digital crimes
2. Understand the various data acquisition methods, understand storage formats, and utilize appropriate tools to collect and analyze digital evidence effectively
3. Comprehend the legal frameworks, privacy concerns, and ethical issues surrounding computer forensics, ensuring adherence to laws and professional standards during investigations
4. Improve their knowledge about the various contemporary software and hardware tools, validating and testing forensic software, and addressing data-hiding techniques.

Module 1: Introduction to Digital Forensics	**No. of Hrs: 8**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

Text Book 1: Chapter 1, Chapter 2

Module 2: Computing Investigations	**No. of Hrs: 8**

Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

Text Book 1: Chapter 8, Chapter 9

Module 3: Data acquisition	**No. of Hrs: 9**

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, perfcrming RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

Text Book 2: Chapter 4

Module 4: Module 4: Processing crimes and incident scenes	**No. of Hrs: 8**

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

Text Book 1: Chapter 12

Module 5: Current computer forensics tools	**No. of Hrs: 9**

Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

Text Book 2: Chapter 5

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

1. Understand the capability to plan and execute corporate investigations involving digital evidence, including securing incident scenes and seizing digital evidence appropriately.
2. Explain various data recovery workstations, selecting suitable acquisition methods, and employing tools to perform RAID and remote network data acquisitions.

3. Understand the storing, and validating digital evidence, including obtaining digital hashes and ensuring the integrity of evidence throughout the investigation process.
4. Explain the specialized investigations, such as email crimes, by understanding email server architectures and utilizing dedicated forensic tools.

Textbooks:

1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

Reference Books:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Web links:

1. Digital Forensics Full Course: https://youtu.be/vD7uJ8aP0zA?si=hiJGUHtyrL8ALiys
2. What is Digital Forensics: https://youtu.be/jrDwZy8I-pg?si=nsux94IsHZNB9rib
3. Digital Forensics: https://youtu.be/JfvHzsexnmc?si=QmXPMlVAtmrzV7TV

Introduction To Machine Learning			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIOE322**	SEE Marks	**50**
Teaching Hrs/Week (L: T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Impartthe knowledgeoncoreconceptsandunderlyingprinciplesofmachinelearning.
2. Familiarize the various data preprocessing techniques.
3. Enable to build basic Machine Learning models using classification, regression, gradient descent algorithms and ensemble methods

Module 1: Foundations of Machine Learning	**No. of Hrs: 8**

Learning Problems, Designing a Learning System, Perspectives & Issues in Machine Learning, A Concept Learning Task, Concepts Learning as Search, Find S, Version Spaces and Candidate Elimination Algorithm, Inductive Bias, Introduction to Machine Learning, Framework for Developing Machine Learning Models

Text Book

Module 2: Dataset Pre-processing	**No. of Hrs: 8**

Data Preparation Tasks: Data Cleaning, Feature Selection, Data Transforms Feature Engineering, Dimensionality Reduction, Data Preparation: Problems with Naïve Data Preparation, Train and Test dataset, K-Fold Cross Validation, Data Cleaning: Basics of Data Cleaning, Outlier Identification and Removal, Marking and Remove Missing Data, Statistical Imputation, Feature Selection :Overview of Feature Selection, Categorical Feature Selection, Numerical Feature Selection, Data Transforms: Scale numerical data, Encoding Categorical Data, Dimensionality Reduction:-LDA,PCA,SVD

Text Book

Module 3: Linear Regression and Gradient Descent	**No. of Hrs: 9**

Linear Regression: Introduction, Steps in Building Linear Regression, Building the Linear Regression Model, Gradient Descent Algorithm, Scikit-Learn Library for Machine Learning: Splitting Dataset, Building Regression Model ,Prediction, Measuring Accuracy- R Squared Value, RMSE, Bias-Variance Trade-off, K-fold Cross Validation, Advanced Regression Model: Building Regression Model for IPL Dataset**,** Applying Regularization

Text Book

Module 4: Classification	**No. of Hrs: 9**

Overview of Classification Problems ,Binary Logistic Regression, Credit Classification example, Model Evaluation: Receiver Operating Characteristic (ROC) and Area Under the Curve (AUC), Confusion Matrix, Finding Optimal Classification Cut-off: Youden's index, Cost-based approach, K-Nearest Neighbors, Bayes Theorem: Bayes Theorem & Concept Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Learning to Classify Text, Bayesian Belief Network, EM Algorithm

Text Book

Module 5: Advanced Machine Learning Algorithms	**No. of Hrs: 8**

Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting, Stacking, Clustering: K-Means Clustering, Support Vector Machines (SVM): Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, Decision Function and Predictions, Training Objective.

Text Book

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

1. Describe the foundational concepts of Concept Learning & Machine learning.
2. Applies the essential data preparation techniques for robust and efficient machine learning implementations.
3. Apply regression model and gradient descent algorithm to various realistic dataset & evaluate the performance evaluation of models.
4. Apply various Classification algorithms to realistic dataset & evaluate the performance evaluation of models.
5. Apply ensemble approach, SVM&K-Means algorithms to realistic dataset and finetune the model for performance increase

Textbooks:

1. Tom M. Mitchell, "Machine Learning", McGrawHill,2003
2. Jason Brownlee: Data Preparation for Machine Learning: Data Cleaning, Feature Selection ,and Data Transforms in Python,2020
3. Manaranjan Pradhan, U Dinesh kumar, "Machine LearningusingPython",Wiley,2019
4. AurelienGeron,"Hands-OnMachineLearningwithScikit-Learn,Keras,andTensorFlow",2ndEdition,O'ReillyPublisher,2019

Reference Books:

1. Andreas C. Müller, Sarah Guido,"Introduction to Machine Learning with Python A Guide for Data Scientists",1st Edition,O'ReillyPublisher,2016

Web links:

1. NPTEL Course on Machine Learning :http://digimat.in/nptel/courses/video/106105152/L01.html
2. Youtube Course on Machine Learning :https://www.youtube.com/watch?v=LcWFedjaR4Q

Introduction to Data Science			
Semester	**VI**	CIE Marks	**50**
Course Code	**23CIOE323**	SEE Mars	**50**
Teaching Hrs/Week(L:T:P)	**3:0:0**	Exam Hrs	**03**
Total Hrs	**42**	Credits	**03**

Course Learning Objectives: This course is designed to

1. Familiarize the fundamentals of data science.
2. Explain data collection, preprocessing, and statistical methods.
3. Analyze relationships between data using machine learning and statistical techniques
4. Develop proficiency in Python data wrangling.
5. Design and implement effective data visualizations.

Module 1: Introduction to Data Science & Statistical Foundations	**No.ofHrs:8**

Data Science, Why Now?, Datafication, The Current Landscape, Data Science Jobs and Profile, Academia vs. Industry Roles, Statistical Thinking in Big Data, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Assumptions, Modeling, Exploratory Data Analysis, Philosophy of EDA, The Data Science Process, A Data Scientist's Role, Case Study: RealDirect
Textbook1: Chapter1, Chapter 2

Module 2: Machine Learning Algorithms & Applications	**No.ofHrs:8**

Machine Learning Algorithms, Linear Regression, k-Nearest Neighbors (k-NN), k-Means Clustering, Hands-on Exercise: Basic Machine Learning Algorithms, Why Linear Regression and k-NN Don't Work for Spam Filtering, Naive Bayes and Bayes' Law, Spam Filtering Using Naive Bayes, Laplace Smoothing, Comparing Naive Bayes to k-NN, Data Wrangling and Web Scraping, APIs and Tools for Data Collection, Naive Bayes for Text Classification
Textbook1: Chapter3, Chapter4

Module 3: Logistic Regression, Financial Modeling & Optimization	**No.ofHrs:8**

Logistic Regression, Interpretability and Scalability, M6D Logistic Regression Case Study, Click Models, Newton's Method and Stochastic Gradient Descent, Model Implementation and Evaluation, Time Stamps and Data Analysis, Financial Modeling Concepts, Preparing and Processing Financial Data, Log Returns and Volatility Measurement, Regression and Bayesian Priors, Financial Modeling Feedback Loop
Textbook1: Chapter5, Chapter6

Module 4: Feature Engineering & Recommendation Systems	**No.ofHrs:8**

Feature Selection Methods, Decision Trees and Random Forests, Filters and Wrappers, Embedded Feature Selection Methods, User Retention Analysis, Google's Hybrid Approach to Social Research, Privacy Considerations, Recommendation Systems, Nearest Neighbor Review and Limitations, Beyond Nearest Neighbor: Machine Learning Approaches, Dimensionality Reduction using PCA and SVD, Alternating Least Squares, Recommender System
Textbook1: Chapter 7, Chapter 8

Module 5: Data Visualization & Fraud Detection	**No.ofHrs:10**

History and Evolution of Data Visualization, Thought Experiments in Data Science, Data Visualization Projects and Applications, New York Times Data Visualization Case Studies, Goals of Effective Data Visualization, Fraud Detection and Risk Analysi , Model Building

and Performance Estimation, Case Study: Data Visualization at Square, Data Science and Risk Management, Data Visualization Exercise
Textbook1: Chapter 9

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

1. Understand and apply core data science concepts in practical scenarios.
2. Describe and summarize data using statistical methods such as inference and modeling.
3. Use regression, classification, and clustering techniques to analyze relationships in data.
4. Implement data wrangling, feature engineering, and machine learning models using R.
5. Develop and apply data visualization techniques for better data-driven decision-making.

Text Books:

1. Cathy O Neil, Rachel Schutt, 2014, "Doing Data Science-Straight Talk from the Frontline", Orielly
2. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, 2014 Mining of Massive Data Sets, Cambridge University Press

Reference Books:

1. Kevin Murphy, 2013, Machine learning: A Probabalistic Perspective
2. Peter Bruce, Andre Bruce, Practical Statistics for Data Scientists, Orielly Series

Weblinks:

1. NPTEL course on Data Science: https://archive.nptel.ac.in/courses/106/106/106106179/
2. Course on Power BI: https://www.youtube.com/watch?v=TBVss5711QM&t=2s

Yoga - IV			
Semester	**VI**	CIE Marks	**100**
Course Code	**23NMCC325**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Empower students to achieve and maintain good health.
2. Promote the practice of mental hygiene.
3. Facilitate students in attaining emotional stability
4. Impart moral values and higher level of consciousness

Contents: **No. of Hrs: 13**

- Ashtanga Yoga 1. Dharana 2. Dhyana (Meditation) 3. Samadhi
- Asana by name, technique, precautionary measures and benefits of each asana
- Suryanamaskar13 count- 4 rounds of practice
- Different types of Asanas

a) Sitting
   1. Bakasana
   2. Hanumanasana
   3. EkapadaRajakapotasana
   4. Yogamudra in Vajrasana

b) Standing
   1. Vatayanasana
   2. Garudasana

c) Balancing
   1. Veerabhadrasana
   2. Sheershasana

d) Supine line
   1. Sarvangasana
   2. Setubandha Sarvangasana
   3. Shavasanaa (Relaxation posture)

- Revision of Kapalabhati practice 40 strokes/min - 3 rounds
- Meaning by name, technique, precautionary measures and benefits of Pranayama Bhramari.

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

1. Describe the meaning, aim and objectives of Yoga.
2. Perform Suryanamaskar and able to analyze its benefits.
3. Exhibit the different Asanas by name, its importance, methods and benefits.
4. Perform Kapalabhati.
5. Perform the different types of Pranayama by its name, precautions, procedure and uses.

Textbooks:

1. Ajitkumar ,"YogaPravesha in Kannada" 1st Edition, Raashtroththaana Saahithya, 2017,ISBN-13: 978-8175310124
2. BKS Iyengar, "Light on Yoga", 1st Edition, Thorsons, 2017, ISBN-13: 978-0008267919
3. Dr. M L Gharote& Dr. S K Ganguly,"Teaching Methods for Yogic practices", 1st Edition, Kaivalyadhama, 2001, ISBN-13 : 978-8189485252

Reference Books:

1. YaminiMuthanna, "Yoga for Children step by step", 1st Edition, Om Books International, 2022, ISBN-13: 978-9394547018

Web links:

1. My Life My Yoga: https://youtu.be/KB-TYlgd1wE
2. Adiyoga: https://youtu.be/aa-TG0Wg1Ls

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Quiz	20
2	Practical demonstration	50
3	Final Report	30
	Total	**100**

Physical Education - IV			
Semester	**VI**	CIE Marks	**100**
Course Code	**23NMCC326**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Impart the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Build a strong foundation for the professionals in Physical Education and Sports

Contents:	**No. of Hrs: 13**

- Importance of nutrition for optimal performance and healthy eating habits. (Lectures)
- Mindfulness and stress management techniques like meditation. (Practical Sessions)
- Emphasis on teamwork, communication, and sportsmanship. (Practical Sessions)
- Specific Games (Students continue prior semester's game by practicing Advanced Skills)

Basket Ball	Behind-the-back dribble - Spin moves - Alley-oop passes - Shooting off the dribble - Advanced footwork and shot creation techniques
Cricket	Reverse swing and googly bowling - Spin bowling variations (leg spin, off spin) - Captaincy skills - Advanced batting techniques (switch hitting)
Football	Advanced dribbling techniques (stepovers, fakes) - First touch passing and control - Volley control and shooting - Set pieces (free kicks, corner kicks) Advanced heading techniques - Goalkeeper diving and shot-stopping
Hockey	Deke moves and advanced stickhandling - Aerial control - Passing variations (chip pass, scoop pass) - Penalty corner techniq es - Advanced defensive strategies
Kabaddi	Advanced raiding maneuvers (super raid) - Quick and deceptive raiding holds - Strategic raiding based on game situation - Strong team defense coordination - Advanced anti-raid tactics
Karate	Advanced kumite strategies and tactics - Complex combinations of attacks and counters - Throwing and takedown techniques (sweeps, trips) - Advanced conditioning and strength training
Table Tennis	Advanced footwork for quick movement - Smashing technique - Serving variations (sidespin, flick serve) - Deceptive spins and tactics - Advanced match play strategies
Throw ball	Jump shot and other variations - No-look passes and behind-the-back passes - Quick throws and fast breaks - Advanced dodging techniques and footwork - Zone defense and press defense strategies
Volleyball	Offensive spiking mechanics (jumping and hitting the ball

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

1. Demonstrate an understanding of the link between nutrition, performance, and healthy eating habits
2. Demonstrate improved self-awareness, stress management skills, and effective teamwork through participation in sportsmanship-focused activities.
3. Perform in the selected sports or athletic events

Textbooks:

1. Muller, J. P., "Health, Exercise and Fitness", 1st Edition, Sports Publication, 2018
2. Uppal, A.K., "Physical Fitness", Friends Publication New Delhi, 1992.
3. Russell R.P., "Health & Fitness through Physical Education: Human Kinematics", Human Kinetics Publishers, 1994

Reference Books:

1. Anaika, "Play Field Manual", Friends Publication New Delhi, 2005
2. IAAF Manual
3. Pinto John & Roshan Kumar Shetty, "Introduction to Physical Education"

Web links:

1. https://www.youtube.com/watch?v=wvlztaJYKYI
2. https://www.youtube.com/watch?v=d393LzvqG3E&list=PL94CA1fTzfEd8FkpCa0WNTF7y1pFWNFKc
3. https://www.youtube.com/watch?v=m7EhWv4wgP4

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Participation of students	20
2	Quizzes-2, each of 15 marks	30
3	Final presentation/Exhibition/Participation in Competitions	50
	Total	**100**

National Service Scheme - IV			
Semester	**VI**	CIE Marks	**100**
Course Code	**23NMCC327**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. Develop discipline, character, brotherhood, the spirit of adventure and ideals of selfless service amongst young citizens
2. Develop youth leadership in the students
3. Induce social consciousness among students through various societal activities.
4. Impart knowledge in finding practical solutions to individual and community problems

Contents: **No. of Hrs: 13**

Introduction:

- Basic first aid skills
- Disaster preparedness, emergency evacuation

Activities:

- Environment Awareness and Conservation
- Obstacle management Training, conflict management and negotiation skills

Note:

- Students in individual or in a group should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department
- At the end of every semester, activity report should be submitted for evaluation

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

1. Understand the importance of nation building and individual contribution to the betterment of the society
2. Discover grassroots challenges of community and solve them by technological intervention
3. Create societal impact by upholding the value of one for all and all for one
4. Maintain discipline and team spirit

Textbooks:

1. Ministry of Youth Affairs & Sports, Government of India (2022) "National Service Scheme Manual"
2. Rajiv Gandhi National Institute of Youth Development, Ministry of Youth Affairs & Sports, Government of India, (2017)"Introduction Training Module for National Service Scheme (NSS) Program officers"
3. Gurmeet Hans (1996), "Case material as Training Aid for field workers" TISS

Reference Books:

1. Dr. G R Bannerjee, (2012),Social service opportunities in Hospitals, TISS
2. Ram Ahuja (Third Edition, 2014), Social Problems in India, Rawat publications

Web links:

1. History of NSS :https://thebetterindia.com/140/national-service-scheme-nss/
2. NSS – an introduction https://www.youtube.com/@nationalserviceschemeoffic4034/videos

Scheme & Assessment:

Sl.No.	Activity	Marks
1	Participation of students	30
2	Individual contribution to success of the program	40
3	Report preparation	30
	Total	**100**

Arts - IV			
Semester	**VI**	CIE Marks	**100**
Course Code	**23NMCC328**	SEE Marks	**-**
Teaching Hrs/Week (L:T: P)	**0:0:1**	Exam Hrs	**-**
Total Hrs	**13**	Credits	**-**

Course Learning Objectives: This course is designed to

1. To impart an understanding of the creative process from initial concept to final execution
2. Create and demonstrate proficiency in a chosen arts discipline through practical application
3. Analyze and appreciate diverse art forms and styles
4. To participate in art competitions at regional, state, national, and international levels, as well as in cultural events

Contents: **No. of Hrs: 13**

Note: Student will continue the arts form selected in previous semester.

Performing Arts (Dance)	Orientation, Cinema Script Writing, Audition Techniques, Shooting Script, Basics Direction and Camera, Group Assignments, Group Presentation, Evaluation.
Arts & Crafts	Orientation, Puppetry: Glow Puppetry- Head Puppets -Animal Puppetry -POP Puppetry- Group Presentation- Evaluation
Theatre	Orientation, Theatre Music, Theatre Choreography, Script Writing, Group Production, Grand Rehearsals, Group Show, Evaluation.

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

1. To be capable of creating choreography and delivering live performances for an audience.
2. Employ a range of acting techniques and use them to create a performance.
3. Evolve into creative, effective, independent, and reflective individuals capable of making informed decisions in both process and performance.
4. Acquire knowledge and comprehension of the roles and processes used in current theatre arts practice.

Textbooks:

1. Music in Theory and Practice by Bruce Benward and Marilyn Sake, McGraw-Hill Education,2014
2. Art Fundamentals: Theory and Practice by Otto G. Ocvirk, Robert E. Stinson, Philip R. Wigg, Robert Bone, and David L. Cayton, McGraw-Hill Education,2012
3. The Viewpoints Book: A Practical Guide to Viewpoints and Composition by Anne Bogart and Tina Landau, Theatre Communications Group,2004

Reference Books:

1. Dance Composition: A practical guide to creative success in dance making, Jacqueline M. Smith
2. The Artist's handbook of method and materials by Ralph Mayer
3. Glimpses of Indian music and dance by Dr. Arun Bangre

Web links:

1. https://ccrtindia.gov.in/audio-visual-catalogue/

Scheme & Assessment:

Sl. No.	Activity	Marks
1	Students Participation	20
2	Quizzes-2 (each of 15 marks)	30
3	Final presentation/Exhibition/Participation in Competitions	50
	Total	**100**