BE SCHEME & SYLLABUS

Third Year
(V and VI Semester)

With effect from 2022-23

Computer Science & Business Systems

ST JOSEPH ENGINEERING COLLEGE
AN AUTONOMOUS INSTITUTION
Vamanjoor, Mangaluru - 575028

MOTTO

Service & Excellence

VISION

To be a global premier Institution of professional education and research.

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E.(CSE,ECE,EEE, ME and CIV) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2022-23)

Computer Science and Business Systems

THIRD YEAR

(V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of PG programs, namely, MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

CONTENTS

ABOUT THE DEPARTMENT

SJEC takes pride to launch in partnership with India's leading IT Service and Consulting Company – TCS, an industry ready BE Programme titled Computer Science and Business Systems (CSBS) to cater to the rising need of engineering talent with skills in Business Systems. This Four-Year undergraduate degree programme is offered with an intake of 60, Autonomous under VTU -Belagavi. This state of-the-art programme aims to impart knowledge of cutting-edge technologies and business skills with hands-on exposure to help the students be industry-ready.

The Computer Science and Business Systems programme in collaboration with TCS aims to expose students not only to the core topics of Computer Science but also develop an equal understanding of humanities, human values and management sciences. This programme is an apt choice for students aspiring to be business leads in the IT industry. Students will also gain excellent industrial exposure on emerging topics such as Business Analytics, Machine Learning, Cloud Computing, Internet of Things etc.

DEPARTMENT VISION

To impart value-based quality education with the motive of transforming mankind with excellence and competing areas of engineering, technology and management.

DEPARTMENT MISSION

1. Focus on the practical aspects of the curriculum to make learning a meaningful and interesting experience.
2. Encourage active collaboration with industries, communities, and fellow institutions within the country and abroad.
3. Infuse strong moral and ethical principles in students in order to make them conscientious citizens and excellent human beings.
4. Cultivate the competitive spirit required for success.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide students with a solid foundation and the ability to use engineering concepts, mathematics, physics, and humanities required to develop, analyse, design, and implement solutions to the problems in intelligent computing and business systems.
2. To develop in students, the knowledge of computer science and engineering to work in domains such as artificial intelligence, machine learning and data science.
3. To foster in students, the capacity of teamwork through efficient communication in multidisciplinary projects.
4. To prepare students for building successful careers in artificial intelligence, data science and business systems to meet the needs of society while incorporating professional ethics.
5. To inspire learners to pursue higher education in their desired fields and engage in research.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations on complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and the synthesis of information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. **Entrepreneurship and Freelancing**: Recognize the tenets of entrepreneurship, freelancing and the prerequisites for starting a business in the IT or related fields.

2. **Competitive Exams**: Participate skillfully in competitive examinations for certification, professional advancement, and admission to higher studies.

V Semester (B.E. - Computer Science and Business Systems)													
SI. No	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	HSMC	22CBS51	Fundamentals of Management	CBS	CBS	3	-	-	03	50	50	100	3
2	IPCC	22CBS52	Database Management Systems (Integrated)	CBS	CBS	3	-	2	03	50	50	100	4
3	IPCC	22CBS53	Computer Networks and Security (Integrated)	CBS	CBS	3	-	2	03	50	50	100	4
4	PCC	22CBS54	Operation Research	CBS	CBS	2	2	-	03	50	50	100	3
5	PCCL	22CBS55L	Computational Statistics Laboratory	CBS	CBS	-	-	2	03	50	50	100	1
6	PEC	22CBS56X	Professional Elective - I	CBS	CBS	3	-	-	03	50	50	100	3
7	AEC/SDC	22RMI57	Research Methodology and Intellectual Property Rights	CBS	CBS	2	-	-	03	50	50	100	2
8	AEC/ SDC	22ETP58	Emerging Technologies: A Primer	COM	COM	-	-	2	03	100	-	100	1
					Total	**16**	**2**	**8**	**24**	**450**	**350**	**800**	**21**

22CBS56X : Professional Elective I			
22CBS561	Data Mining and Data Warehousing	22CBS563	Cryptography and Cyber Security
22CBS562	Financial and Cost Accounting	22CBS564	Business Strategy

VI Semester (B.E. - Computer Science and Business Systems)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	IPCC	22CBS61	Fundamentals of AI and ML **(**Integrated Course)	CBS	CBS	3	-	2	03	50	50	100	4
2	IPCC	22CBS62	Automata Theory and Compiler Design **(**Integrated Course)	CBS	CBS	3	-	2	03	50	50	100	4
3	PCC	22CBS63	Marketing Research and Marketing Management	CBS	CBS	3	-	-	03	50	50	100	3
4	PEC	22CBS64X	Professional Elective -II	CBS	CBS	3	-	-	03	50	50	100	3
5	OEC	22CBS65X	Open Elective -I	CBS	CBS	3	-	-	03	50	50	100	3
6	PRJ	22CBS66	Major Project Phase - I	CBS	CBS	-	-	4	03	100	-	100	2
7	HSMC	22CIV67	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
8	AEC/SDC	22IIP68	Innovation and Intellectual Property	COM	COM	-	-	2	03	100	-	100	1
Total						**16**	**-**	**10**	**23**	**500**	**300**	**800**	**21**

22CBS64X : Professional Elective II			
22CBS641	Enterprise Systems	22CBS643	Human Resource Management
22CBS642	Blockchain Technology	22CBS644	Natural Language Processing

22CBS65X : Open Elective I			
22CBS651	Introduction to AI and ML	22CBS653	Introduction to Computer Vision
22CBS652	Business Strategy	22CBS654	Predictive Analytics

V Semester

Fundamentals of Management			
Course Code	**22CBS51**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Manage business organizations in the dynamic global environment
- Understand and maintain competitive advantage in organizations
- Take decisions using various tools and techniques to remain competitive in business
- Develop strategies and critical thinking skills to solve real-life situations
- Discuss different areas of the business (i.e., Manufacturing/Service, Marketing, Finance and Human Resource Management) .

Module-1 Introduction to Management **8 hours**

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management-Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.
TB1, TB2

Module-2 Planning and Decision Making **8 hours**

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.
TB1, TB2

Module-3 Organization and HRM **8 hours**

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change. Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.
TB1, TB2

Module-4 Leading and Motivation **8 hours**

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.
TB1, TB2

Module-5 Controlling **8 hours**

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency, and Methods.
TB1, TB2

Course Outcomes: At the end of the course the student will be able to:	
22CBS51.1	Apply the primary functions of management and the roles of managers, contributions to field of management.
22CBS51.2	Explain planning, decision-making, and problem-solving in managerial contexts.
22CBS51.3	Explain principles of organization design, HRM strategies, talent management, and organizational change in diverse contexts.
22CBS51.4	Build leadership competence, analyze styles, and apply crisis management, ensuring effective team leadership in various situations..
22CBS51.5	Illustrate the intricacies of motivation types, analyze their impact on performance, and apply motivational theories effectively.
22CBS51.6	Analyze control types, strategies, and apply effective control systems, fostering organizational performance and efficiency.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Management Fundamentals	Robert N Lussier	Cengage Learning,	5th Edition, 2013
2	Fundamentals of Management,	Stephen P Robbins,	Pearson Education, 2009.	9th Edition, 2016
Reference Books				
1	Essentials of Management	Koontz Kleihrich	Tata McGraw Hill	8th Edition, 2009
2	Management Essentials	Andrew DuBrin	Cengage Learning	9th Edition, 2012

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/109105121/
- http://nptel.ac.in/courses/122105021/
- https://en.wikipedia.org/wiki/Management
- https://iedunote.com/planning-decision-making-relation
- https://www.sciencedirect.com/science/article/pii/.../pdf?md5...pid=1-s2.0...1
- smallbusiness.chron.com › Managing Employees › Employees
- www.businessmanagementideas.com/advertisement/controlling...management.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS51.1		1								3	3	1	1	
22CBS51.2		1								2	2		1	
22CBS51.3								2			3			
22CBS51.4		2							3	2		1		
22CBS51.5		2							2	2		1	1	
22CBS51.6		1								2	1			

1: Low 2: Medium 3: High

Database Management Systems			
Course Code	**22CBS52**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 Hours + 10 Lab Slots	Credits	04

Course Learning Objectives: The objective of the course is

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in the database.
- Design and build database applications for real world problems.

Module-1: Introduction **8 hours**

Introduction to Databases: Introduction, simplified database system environment, Characteristics of database approach, Actors on the scene, Workers behind the scene, Advantages of using the DBMS approach.

Database Concepts and Architectures: Data Models, Schemas and Instances. Three schema architecture and data independence, database languages and interfaces, Component modules of a DBMS and their Interactions.

Data Model: Main phases of a Database Design Process, Entity Types, Entity Sets, Attributes, Keys, Relationship Types, Sets, Roles and Structural Constraints, ER diagram Notations and examples.

Ch: 1.1, 1.3 - 1.6, 2.1- 2.3, 2.4.1, 3.1, 3.3.1, 3.3.2, 3.4, 3.7

Module-2: Relational Model **8 hours**

Relational Model: Relational Model Concepts, Relational Model Constraints and schemas, Update Operations and Dealing with Constraint violations, Relational database design using ER to Relational Mapping

SQL: SQL data definition and data types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, More Complex SQL Retrieval Queries, Specifying Constraints as Assertions and Triggers, Views in SQL, Schema Change Statements in SQL.

Ch: 5.1 - 5.3, 6.1 - 6.4, 7.1 - 7.4

Module-3 SQL & JDBC **(8 hours)**

Relational Algebra & Design: Unary and Binary relational operations, Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra.

Database Application Development: Embedded SQL, Dynamic SQL, SQLJ, Database Programming with Function calls: SQL and JDBC, Database Stored Procedures.

Ch: 8.1 - 8.5, 10.2, 10.3, 10.4

Module-4: Normalization **8 hours**

Normalization and its Algorithms: Informal design guidelines for relation schema, Functional Dependency (Inference Rules, Equivalence, and Minimal Cover) , 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, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Dangling tuples.

Ch: 14.1 - 14.7,15.2 - 15.4

Module-5: Transaction Processing & database Recovery **8 hours**

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on recoverability, characterizing schedules based on Serializability, Two-phase locking techniques for Concurrency control.

Database Recovery Protocols: Recovery Concepts, NO-UNDO/REDO algorithm, Recovery techniques based on immediate update, Shadow paging, ARIES recovery algorithm.

Database Security: Database security issues-Types of security and control measures, SQL Injection, Challenges to Maintaining Database Security.
Ch: 20.1 - 20.5, 21.1, 22.1 - 22.5, 30.1, 30.4, 30.9

PRACTICALMODULE

Design, develop, and implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment. Create Schema and insert at least 5 records for each table. Add appropriate database constraints.

1. Write Schema and ER Diagram for Bank Database/ College Database. Demonstrate mapping of ER- diagram to Relational Schema model.
(Drawing tool like "drawio" can be explored if required)
2. The Company database of an organization has a table with following attributes
EMPLOYEE (empid:int, empname:string, Doj:date, department:string, salary:decimal)
   i. Create above tables using suitable constraints
   ii. Enter 5 tuples into the table
   iii. Display number of employee working in each department
   iv. Find the sum and average of salaries of employees of a particular department
   v. Find the empid and emp_name of all the employees who has salary not equal to 25000 or 30000
   vi. Display all records who's name starts with and ends with A and has atleast 4 characters.
3. The College Database has following tables
   DEPARTMENT (DEPT_ID: int, DEPT_NAME: string)
   STUDENT (STUD_ID:int, STUD_NAME:String,AGE: int, DOB: date,ADDRESS: String, DEPT_NO:int)
   SUBJECT (SUBJECT_ID:int, SUBJECT_NAME:String,DEPT_NO:int)
   TEACHER (TEACHER_ID:int,TEACHER_NAME:String,SUB_NO:int,DEPT_NO: int)
Create tables using suitable constraints, Insert 10 sample data into the table and perform following operations
   i. List all the students' details studying in Computer Science Department
   ii. List all the teachers teaching in EEE Department
   iii. List the subject offered by Computer Science Department
   iv. Change the date type of STUD_ID from integer to string
   v. Add new attribute STUD_Phno to the existing STUDENT table
   vi. Combine each row of Student table with each row of Subject table
   vii. Create a student table view
   viii. Display the names of the students who opted DBMS subject
4. Consider the following schema for Order Database:
   SALESMAN(Salesman_id, Name, City, Commission)
   CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id)
   ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id)
   Create tables using suitable constraints, Insert 10 sample data into the table and Write SQL queries to
   i. Count the customers with grades above Bangalore's average.
   ii. Find the name and numbers of all salesman who had more than one customer.
   iii. List all the salesman and indicate those who have and don't have customers in
   iv. their cities (Use UNION operation.)
   v. Create a view that finds the salesman who has the customer with the highest order of a day.
   vi. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
5. Consider the schema for Company Database:
   EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo)

DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate)
DLOCATION(DNo,DLoc)
PROJECT(PNo, PName, PLocation, DNo)
WORKS_ON(SSN, PNo, Hours)
Create tables using suitable constraints, Insert 10 sample data into the table and Write SQL queries to

i. Find the sum of the salaries of all employees, the maximum salary, the minimum salary and the average salary.
ii. Select the total number of employees in the company and the number of employees in the ''Research' department
iii. Retrieve all employees whose address is in "Houston, Texas" (LIKE)
iv. Find all employees who were born during the 1970s (LIKE)
v. Retrieve all employees in department 5 whose salary is between $30,000 and $40,000 (BETWEEN)

Mini Project (Open Ended Problem)

Use Java, HTML, Python, or any other similar front-end tool. All applications must be demonstrated on desktop/laptop as a stand-alone or web-based application (Mobile apps on Android/IOS are not permitted)

Course Outcomes: At the end of the course the student will be able to:	
22CBS52.1	Identify attributes, entities and relationships of the given system and draw Entity Relationship Diagrams.
22CBS52.2	Apply relational database schema for the given application and develop queries in relational algebraic expressions
22CBS52.3	Implement basic and complex queries using SQL to retrieve the required information from database
22CBS52.4	Apply normalization steps in database design using the design guidelines and functional dependencies
22CBS52.5	Analyze the issues associated with Transaction Processing and relate the concept of query optimization.
22CBS52.6	Develop a database application system using advanced SQL tools and interfaces with appropriate documentation by incorporating ethical standards

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Higher Fundamentals of Database Systems	Ramez Elmasri, Shamkant B. Navathe	Pearson	7th Edition, 2017
Reference Books				
1	Database System Concepts	Silberschatz Korth, Sudharshan	McGraw Hill	6th Edition, 2013
2	Database Principles Fundamentals of Design, Implementation and Management	Coronel, Morris, and Rob	Cengage Learning	9th Edition, 2012
3	Database management systems	Ramakrishnan, Gehrke	McGraw Hill	3rd Edition, 2014

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/106/106106095/
- https://nptel.ac.in/courses/106/106/106106220/
- https://www.youtube.com/watch?v=3EJlovevfcA
- https://www.youtube.com/watch?v=c5HAwKX-suM
- https://www.youtube.com/watch?v=mXc81thXi1E
- https://www.youtube.com/watch?v=3EJlovevfcA

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS52.1	1	2												
22CBS52.2			2											
22CBS52.3			2		1									2
22CBS52.4	1				2									
22CBS52.5	2					1								
22CBS52.6			3		2			1			1			2

1: Low 2: Medium 3: High

Computer Networks and Security			
Course Code	**22CBS53**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Comprehend the transmission technique of digital data between multiple computers and understand the fundamentals of data communication networks.
- Analyze the applications of various network core devices and protocols in data communication.
- Explain routers, IP and Routing Algorithms in network layer
- Implement different protocols and analyze the network performance.

Module-1 Introduction and Physical Layer **8 hours**

Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP Protocol suite, The OSI model.

Physical Layer: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance, Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding), Analog to digital conversion (only PCM), Transmission Modes, Digital to analog conversion.

TB1

Module-2 Data Link Layer **8 hours**

Introduction to Data-Link Layer: Introduction, DLC services, Data link layer protocols, Point to Point protocol (Framing, Transition phases only), Link-Layer Addressing, ARP

Switching: Introduction, Circuit Switched Networks and Packet switching.

Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum,

Media Access control: Random Access, Controlled Access and Channelization.

TB1

Module-3 Network and Transport Layer **8 hours**

What's Inside a Router? Input Processing, Switching, Output Processing, Where Does Queuing Occur?, Classful and CIDR addressing, IPv6, Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm

Transport Layer: Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Connectionless Transport: UDP, UDP Segment Structure, UDP Checksum, Go-Back-N, Selective repeat

TB2

Module-4 Transport & Application Layer **8 hours**

Transport Layer: Connection-Oriented Transport TCP: TCP Segment Structure, Round-Trip Time Estimation and Timeout, Flow Control, TCP Connection Management, Principles of Congestion Control, Approaches to Congestion Control

Application Layer: Principles of Network Applications: Network Application Architectures, Processes Communicating, Application-Layer Protocols. The Web and HTTP: Overview of HTTP, Non-persistent and Persistent Connections, HTTP Message Format, FTP, SMTP, Mail Message Format, Mail Access Protocols, DNS, Overview of How DNS Works, DNS Records and Messages

TB2

Module-5 Security in Computer Networks **8 hours**

What is network security?, Principles of Cryptography, Message Integrity and digital signatures, End point authentication, Securing Email, Securing TCP connection: SSL, Network layer security: IPSec & VPNs, Securing wireless LAN, Firewalls, Intrusion Detection Systems.

TB2

PRACTICAL MODULE

1. Network System Administration: Understanding the basic network configuration and installation.
2. Implement a TCP based client server program in python using TCP sockets where Server displays the following:
   a) Host Name, IP address and Port Number on which it is hosted
   b) IP address and port number of a client requesting connection. Server sends the message "Thanks for Connecting!" back to client. Client displays this message on screen.
3. Implement a UDP based client server program in python using UDP sockets where Server displays the following:
   a) Host Name, IP address and Port Number on which it is hosted
   b) IP address and port number of a client sending some dummy message. Server displays the dummy message on screen. Server sends the message "Thanks for Message!" back to client. Client displays this message on screen.
4. Develop a program for error detecting code using CRC-CCITT (16- bits)
5. Develop a program to implement a sliding window protocol in the data link layer.
6. Write a program in Java/Python to find the shortest path between vertices using Distance-Vector (DV) Routing Algorithm.
7. Write a program in Java/Python to implement congestion control using Leaky Bucket algorithm
8. Write a program in Java/Python to perform encryption and decryption using the following algorithms
   I. Ceaser cipher
   II. Substitution cipher
   III. Hill Cipher

OPEN ENDED EXPERIMENT

1. Implement a program in Java/Python to perform encryption and decryption using RSA algorithm
2. Perform Network Analysis using Wireshark tool.

Course Outcomes: At the end of the course the student will be able to:	
22CBS53.1	Explain the fundamental principles involved in data communication
22CBS53.2	Describe the different switching mechanisms and data link layer protocols for digital communication
22CBS53.3	Discuss the working of routing protocols and different processes involved in sending messages at transport layer
22CBS53.4	Identify the essential principles of a transport layer and application layer protocol and explain how they are used to solve computer networking problems.
22CBS53.5	Apply the basic concepts of cryptography to identify the security attacks and services and to select appropriate security protocols for a particular scenario
22CBS53.6	Analyze the current architecture of the internet and the entities involved in the day to day running of the internet using several applications.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Data Communications and Networking	Behrouz A. Forouzan	Tata McGraw-Hill	5th Edition, 2013

2	Computer Networking, A Top-Down Approach,	James F Kurose and Keith W Ross	Pearson Education,	7th Edition, 2017
Reference Books				
1	Computer-Networks-	Andrew S. Tanenbaum and David J. Wetherall	Pearson Education,	6th Edition, 2021
2	Computer Networks,	Larry L Peterson and Brusce S Davie,	ELSEVIER	6th Edition, 2020
3	Computer Networks	Mayank Dave	Cengage Learning	1st Edition, 2012

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/106105183/L01.html
- http://www.digimat.in/nptel/courses/video/106105081/L25.html
- https://nptel.ac.in/courses/106105081
- VTU e-Shikshana Program (https://www.youtube.com/playlist?list=PLcwp2fRcIXJWj0s7kKwekI0iBjc6w30XQ)
- https://docs.python.org/3/howto/sockets.html
- https://docs.python.org/3/library/socket.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS53.1	3		1											1
22CBS53.2	3													
22CBS53.3		1	2											
22CBS53.4	2		1											
22CBS53.5	1		2		2									
22CBS53.6					3						1		1	2

1: Low 2: Medium 3: High

Operation Research			
Course Code	**22CBS54**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Formulate optimization problem with business applications.
- Solve optimization problems using simplex method.
- Devise and solve transportation and assignment problems.
- Understand game theory concepts for decision making problems.

Module-1: Introduction, Linear Programming **8 hours**

Introduction: Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scientific Method in Operations' Research, Necessity of Operations research in Industry, Scope of OR, OR and Decision Making, Phases and Models in OR, classification schemes of Model, Characteristics of a Good Model, Advantages of a Model, Limitations of Model, Constructing the Model, Approximations in OR Models, Types of Mathematical Models, Role of Computers in OR, Difficulties in OR, Limitations of OR.

Linear Programming Problem (LPP): Requirements for a LPP, Assumptions of LPP, Formulation of LPP and Graphical method of solution with various examples

TB1: **Ch 1, 2.1-2.3,2.6,2.9**

Module-2: Simplex Method **8 hours**

Simplex Method – 1: Theory of Simplex method, Some important definitions, Analytical method or trial and error method, The simplex method, Artificial variable Techniques, Big M method, Two phase method, Solutions of Simultaneous Equations by Simplex Method, Computational Efficiency of the Simplex Techniques

TB1: Ch 2.13 - 2.17, 2.19, 2.21

Module-3: The Transportation Model **8 hours**

The Transportation Model: Introduction to the Model, Assumption in the Transportation Model, Definition of the Transportation Model, Matrix Terminology, Formulation and solution of Transportation Models, Variants in Transportation Problems, Additional Problems, Least Time Transportation Problems, Post Optimality Analysis in Transportation, The Trans-Shipment Problem, Dual of the Transportation Problem.

TB1: Ch 3

Module-4: Assignment Problems **8 hours**

Assignment Problems: Definition of the Assignment Model, Mathematical representation of the assignment Model, Comparison with the Transportation, Solution of the Assignment Models, The Hungarian Method for solution of the assignment Problems, Formulation and solution of the Assignment Models, variations of the Assignment Problems, Additional problems, Sensitivity Analysis in the Assignment Problems

TB1: Ch 4

Module-5: Decision Theory and Game Theory **8 hours**

Decision Theory: Steps in decision Theory Approach, Decision Making Environments, Decision Making under Conduction of Certainty, Decision Making under Conditions of Uncertainty, Decision making under Condition of Risk, Maximum Likelihood Criterion, Expected Value Criteria for Continuously Distributed random variables. Additional Examples.

Game Theory: The Theory of games, Characteristics of Games, game models, Definitions, Rules for Game Theory, Rule1: Look for a Pure Strategy, Rule2: Reduce Game by Dominance, Rule 3: Solve for a Mixed Strategy, Mixed Strategies (2x2 games), Limitations of Game theory.

TB1: Ch 9.1 - 9.7, 9.10 - 9.22

Course Outcomes: At the end of the course the student will be able to:	
22CBS54.1	Outline the problem as Linear Programming Problem
22CBS54.2	Apply Big-M Method and Two-phase method for a given problem.
22CBS54.3	Solve Transportation problem to find its optimality.
22CBS54.4	Make use of Hungarian method to solve Assignment Problems
22CBS54.5	Apply Game theory for decision making problems.
22CBS54.6	Analyze the Optimality of the Problem' Solution.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Operations Research	D.S. Hira and Prem Kumar Gupta	S. Chand & Company Pvt. Ltd	7th Edition, 2014
Reference Books				
1	Operation Research	S Kalavathy	Vikas Publishing House Pvt Limited	4th Edition,2013
2	Operation Research	S D Sharma	Kedar Nath, Ram Nath Publishers.	2020th Edition

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=OwNPKGQ3UDY
- https://onlinecourses.nptel.ac.in/noc20_ma23/preview
- https://www.coursera.org/learn/operations-research-modeling
- https://www.youtube.com/watch?v=fSuqTgnCVRg&list=PLabr9RWfBcnp8CT6my-Q89N0o-E6tcM6q
- https://www.youtube.com/watch?v=1NjTFtHAU6U&list=PLjk-OqI4WmPJtjfxB0H_E-1xGKBvexfM7

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS54.1	2												2	
22CBS54.2		2	2										2	
22CBS54.3	2		2											2
22CBS54.4		2	2											2
22CBS54.5	2		2										1	
22CBS54.6				2									1	

1: Low 2: Medium 3: High

Computational Statistics Laboratory			
Course Code	**22CBS55L**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	10 Lab Slots	Credits	01

Course Learning Objectives: The objective of the course is to

- To understand the mean, variance, regression models and error term for use in Multivariate data analysis.
- To understand the correlation between the data for decision making.
- To understand the various tests used for the data analysis.
- To explore various techniques for data analysis and visualize the results

Installation procedure of the required software must be demonstrated.

	PART- A (For Practice)
1.	i. Write a program to calculate and display descriptive statistics for a given dataset. ii. Write a program to create basic plots (histograms, scatter plots, box plots) using a dataset
2.	i. Write a program to clean and pre-process a dataset (handling missing values, outliers, normalization). ii. Write a program to perform basic matrix operations (addition, subtraction, multiplication, transpose).
	PART B
1.	Write a program to implement simple linear regression and plot the regression line.
2.	Program to measure central tendency and measures of dispersion: Mean, Median, Mode, Standard Deviation, Variance, Mean deviation and Quartile deviation for a frequency distribution/data
3.	Implement a program on data wrangling: Combining and merging datasets, Reshaping and Pivoting
4.	Program on Time series: GroupBy Mechanics to display in data vector, multivariate time series and forecasting formats
5.	Program to perform cross validation for a given dataset to measure Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and R2 Error using Validation Set, Leave One Out Cross-Validation (LOOCV) and K-fold Cross-Validation approaches
6.	Program to display Normal, Binomial Poisson, Bernoulli distributions for a given frequency distribution and analyze the results.
7.	Program to implement One-way and Two-way ANOVA tests and analyze the results
8.	Program to implement correlation, rank correlation and regression and plot x-y plot and heat maps of correlation matrices.
9.	Program to implement PCA and LDA on a relevant dataset, visualize and analyze the results
10	Program to Implement multiple linear regression using iris dataset, visualize and analyze the results.
	PART C – Open Ended Programs
1.	Develop a predictive model to determine the survival of passengers on the Titanic. Explore various statistical techniques and machine learning algorithms to improve prediction accuracy. Dataset: Titanic dataset from Kaggle.
2.	Perform customer segmentation based on purchasing behavior and demographic information. Provide insights for targeted marketing strategies. Dataset: Mall Customers dataset from Kaggle.
3.	Conduct an exploratory data analysis (EDA) on the Iris dataset to uncover patterns and relationships between different species of flowers. Visualize the data using various statistical plots and techniques. Dataset: Iris dataset from UCI Machine Learning Repository.

Course Outcomes: At the end of the course the student will be able to:	
22CBS55L.1	Apply statistical tests, correlation, and regression analysis to visualize and interpret data.
22CBS55L.2	Implement time series analysis and cross-validation techniques to evaluate model performance and forecast data.
22CBS55L.3	Analyze central tendency, measures of dispersion, and various probability distributions to summarize and interpret data
22CBS55L.4	Solve dimensionality reduction techniques such as PCA and LDA to visualize and analyze data.
22CBS55L.5	Develop multiple linear regression models to analyze relationships between variables and visualize the results.
22CBS55L.6	Develop real-world applications by using computational statistics methods to address complex data-driven problems.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	An Introduction to Multivariate Statistical Analysis	T.W. Anderson	Wiley	3rd Edition, 2009
2	Applied Multivariate Data Analysis, Vol I & II,	J.D. Jobson	Springer New York, NY	1st Edition, 2012
3	Statistical Tests for Multivariate Analysis	H. Kris	Springer New York, NY	1st Edition, 2012
Reference Books				
1	Probability and Statistics, Schaum's Outline	Murray R.S, John S, R.A. Srinivasan	Mc Graw Hills	4th Edition, 2010
2	Engineering Mathematics	N.P Bali, Dr Manish Goyal	Miller and Freund's	6th Edition, 2001

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=x_gHAly3mJo
- https://www.youtube.com/watch?v=h4jvu8PW8YE
- https://www.youtube.com/watch?v=vnHkTnRFdAU
- https://www.youtube.com/watch?v=ZtS6sQUAh0c
- https://www.youtube.com/watch?v=NHrNVEIHPBY

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS55L.1					2									
22CBS55L.2			2	1										
22CBS55L.3	2		2											
22CBS55L.4	1		2											
22CBS55L.5			2											
22CBS55L.6		2	3											

1: Low 2: Medium 3: High

Data Mining and Data Warehousing			
Course Code	**22CBS561**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the principles of Data warehousing and Data Mining.
- Be familiar with the architecture of Data warehouse and Data Mining system.
- Understand the various Data preprocessing Methods.
- Understand different supervised and unsupervised algorithms.

Module-1 Introduction	**8 hours**
Why data mining, What is data mining, What kinds of data can be mined, What kinds of patterns can be mined, Which Technologies Are used, Which kinds of Applications are targeted, Major issues in data mining. Data mining applications, Data Mining and society. **TB1: Ch.1.1 to 1.7, Ch.13.3**	
Module-2 Data Preprocessing	**8 hours**
An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization. **TB1:Ch.2.1 to 2.6**	
Module-3 Data Warehousing and Online Analytical Processing	**8 hours**
Basic concepts, Data warehouse modeling, OLAP operations, Data cube computation, Data cube computation methods. **TB1: Ch.3.1 to 3.5**	
Module-4 Classification	**8 hours**
Basic Concepts, Decision tree induction, Bayes Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy. **TB1: Ch.6.1 to 6.3, 6.6, 6.7, Ch.7.4**	
Module-5 Cluster Analysis	**8 hours**
Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering. **TB1: Ch.8.1 to 8.5**	

Course Outcomes: At the end of the course the student will be able to:	
22CBS561.1	Utilize the principles of mining and analytical processing
22CBS561.2	Explain appropriate analytical techniques for data analysis
22CBS561.3	Apply OLAP and analytical modeling
22CBS561.4	Examine supervised methodologies with multi-dimensional datasets
22CBS561.5	Examine unsupervised methodologies and parameter tuning
22CBS561.6	Analyze mining and analytical techniques for real time applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Data Mining Concepts and Techniques	Jiawei Han, Jian Pei and Hanghang Tong	Elsevier	4th Edition, 2022
Reference Books				
1	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach, Vipin Kumar	Pearson	2nd Edition, 2021
2.	Data Warehousing, Data Mining & OLAP	Alex Berson and Stephen J. Smith	Tata McGraw – Hill Edition	10th Reprint, 2007

Web links and Video Lectures (e-Resources):

- https://onlinecourses.swayam2.ac.in/cec19_cs01/preview
- https://www.youtube.com/watch?v=m-aKj5ovDfg
- https://nptel.ac.in/courses/106105174
- https://online.stat.psu.edu/stat555/node/11/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS561.1	2								2	2			2	
22CBS561.2		3			3				1	2				
22CBS561.3	3								2	2				
22CBS561.4		2	2		2				2					
22CBS561.5			2			2				3			2	1
22CBS561.6						3						3	3	1

1: Low 2: Medium 3: High

Financial and Cost Accounting			
Course Code	**22CBS562**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the fundamental principles of financial accounting and cost accounting in the context of construction projects.
- Analyze and interpret financial statements and cost reports specific to the construction industry.
- Apply various costing methods to accurately determine and manage project costs for effective financial decision-making.
- Develop skills in managing and allocating financial resources efficiently to ensure project sustainability.

Module-1: Financial Accounting **8 hours**

Financial Accounting: Basic Concept Definitions of Book Keeping and Accounting Objectives and Functions of Accounting Types of Accounts Rules of Debit and Credit, Journal Ledger Trial Balance. Preparation of Final Accounts Adjusting Entry Trading, Profit and Loss Account and Balance Sheet. **TB1.**

Module-2: Capital Budgeting **8 hours**

Budget - Meaning and definitions – Preparation of Functional Budgets – Cash Budget - Sales Budget – Purchases and Production Budget – Flexible Budget.
Capital Budgeting – Nature, Importance and Objectives – Process involved in Capital Budgeting – Kinds of Capital Budgeting Decision. **TB2**

Module-3: Investment Proposals **8 hours**

Methods of Evaluating Investment Proposals –
Payback method – Payback profitability method – Discounted Cash Flow method – Net present – Value method. **TB2.**

Module-4 Costing **8 hours**

Costing concepts –
Meaning and Definition – Objectives – Difference between Cost of Financial Accounting Cost Classification Statement of Cost and Estimation – Methods of Costing – Job Costing and Process Costing. **Reference TB1**

Module-5 Project Accounts **8 hours**

Project Accounts – Preparation of Contract Accounts for each project – Methods of Recording and Reporting Site Accounts to Project Office and from Project Office to Head Office.
Reference TB2

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

22CBS562.1	Describe the basic principles and concepts of Accounting.
22CBS562.2	Comprehend the different financial statements and process involved in budgeting
22CBS562.3	Describe the different elements of costing system and perform analysis on different types of costing system.
22CBS562.4	Describe the method of evaluating investment proposals
22CBS562.5	Apply the knowledge of concepts of finance and cost accounting in construction.
22CBS562.6	Apply the Accounting concepts learnt in solving real world business problems

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Accounting for Management - 2	Bhattacharya S.K. and Dearden John Vani	Educational Books, Mumbai (Latest Edition).	2022
2	Financial Management	M Y Khan, P K Jain	McGraw Hill	7th Edition, 2014
Reference Books				
1	Cost and management Accounting-Part1	K.S.Adiga	Shubha prakashana	1st Edition, 2015
2	Management Accounting 1	Prof. K.S. Nagapathi	R. Chand and Co., New Delhi.	1st Edition,2007
3	Management Accounting, principles and Practices.	Kuchal S.C	Chaitanya Pub. House	7th Edition, 2010

Web links and Video Lectures (e-Resources):

- Cost Accounting and Financial Management - A Complete Study | Udemy
- BAF.pdf (shrigpmcollegeandheri.org)
- How to Read Financial Statements: A Beginner's Guide (hbs.edu)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS562.1	2					1				1				2
22CBS562.2		2												
22CBS562.3												2	1	
22CBS562.4						1						1		
22CBS562.5		2				2							1	
22CBS562.6										2				

1: Low 2: Medium 3: High

Cryptography and Cyber Security			
Course Code	**22CBS563**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Analyze classical encryption techniques for practical application.
- Understand the principles and workings of block ciphers along with their practical applications.
- Acquire knowledge of public-key cryptography, and other public-key cryptosystems.
- Explore various aspects of cybercrime, including its definition, origins, classifications, legal perspectives, and preventive measures.

Module-1: Classical Encryption Techniques **8 hours**

Information and Network Security Concepts: Cybersecurity, Information Security and Network Security, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptography, Network Security, Trust and Trustworthiness, Standards.

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Technique.

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles

TB1: Ch 1, 3, 4

Module-2: Block Cipher Operation **8 hours**

Block Cipher Operation: Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption.

Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm.

TB1: Ch 7, 9

Module-3: Introduction: Why Cybersecurity **8 hours**

Introduction: Why Cybersecurity? Information Security and Cybersecurity, How Do Computers Work Together?, Cyberattacks Today, Security Targets, **Technique and Human Beings:** Psychological Attacks, Phishing, Humans vs. Machines, Can Psychological Attacks Be Prevented?. **Risk :** What Is Risk?, Threats in IT Systems, Countermeasures, Risk Management, Systematic Security Analysis, Risk Management as a PDCA Process.

TB2: Ch 1, 2, 3

Module-4: Cybercrime **8 hours**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Classifications of Cybercrimes, Cybercrime: The Legal Perspective, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era.

Cyber offences: How criminals plan them: Introduction, how criminals plan the attacks, Social Engineering, Cyberstalking, Cybercafé and Cybercrimes, Botnets, Attack Vector, Cloud Computing

TB3: Ch 1, 2

Module-5: Tools used in Cyber Crime and Forensics **8 hours**

Tools and Methods used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Understanding Computer Forensics: Introduction, Historical Background, Digital Forensics Science, The need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching

a Computer Forensics Investigation, Setting up a Computer Forensic Lab, Computer Forensic and Steganography, Relevance of OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics auditing, Antiforensics. **TB3: Ch 4, 7**

Course Outcomes: At the end of the course the student will be able to:	
22CBS563.1	Identify and describe classical encryption techniques, including symmetric ciphers, substitution, and transposition methods.
22CBS563.2	Describe the operation of block cipher modes and the principles behind public-Key cryptosystems.
22CBS563.3	Apply fundamental cybersecurity concepts to assess and manage risks in ITsystems.
22CBS563.4	Analyze network security protocols and intrusion detection systems to protect against network threats.
22CBS563.5	Evaluate software vulnerabilities and implement appropriate security measures.
22CBS563.6	Design security plan for a system that uses different cryptography and cybersecurity principles.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Cryptography and Network Security - Principles andPractice	Dr.William Stallings	Pearson Education	8th Edition, 2023
2	Introduction to Cybersecurity	Robin Sharp	Springer	1st Edition, 2023
3	Cyber Security	Nina Godbole , Sunit Belapure	Wiley	2nd Edition, 2017
Reference Books				
1	Introduction to Cryptography with Coding Theory	Wade Trappe and Lawrence C. Washington	Pearson	2nd Edition, 2005
2	Cybersecurity: A Practical Guide to the Law of Cyber Risk	Jeffrey R. Kosseff	Wiley	1st Edition, 2020
3	Network Security Essentials: Applications and Standards	William Stallings	Pearson	7th Edition, 2017,
4	Cryptography Engineering: Design Principles and Practical Applications	Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno	Wiley	1st Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/classical-cryptosystems
- https://toc.seas.harvard.edu/links/cs-127-cryptography
- https://pll.harvard.edu/subject/cybersecurity
- https://www.coursera.org/learn/cybercrime
- https://learning.edx.org/course/course-v1:RITx+CYBER502x+2T2017/home

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS563.1	2	2						1	1	1	1			
22CBS563.2	2	2						1	1	1	1			
22CBS563.3	3	3												
22CBS563.4	3	3												
22CBS563.5					2	2								
22CBS563.6					1	1		1		1			1	

1: Low 2: Medium 3: High

Business Strategy			
Course Code	**22CBS564**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the strategic management, analyzing and evaluating its application in the business world.
- Explore the objectives and strategy for business
- Explain the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology.
- Analyze complex, unstructured qualitative and quantitative problems

Module-1: Introduction **8 hours**

Introduction: Concept and importance of strategic management, importance of strategic decisions, elements of strategic management, Need for strategy, levels of strategy, strategic management process, changes in the approach to strategic management. **TB1: Ch 1.**

Module-2: Vision and Mission, Objectives and Strategy **8 hours**

Developing strategic vision, communicating the strategic vision, crafting a mission statement, linking vision and mission with company values, levels of objectives, crafting objectives.
Sources of Sustained Competitive Advantage: Introduction and Objectives, How Competitive Advantage Emerges and Is Sustained, Types of Competitive Advantage: Cost and Differentiation
TB1: Ch 2, TB2: Ch 7.

Module-3: Strategic Analysis **8 hours**

Concept, the general environment; scanning, monitoring and forecasting the environment, Scenario planning, PEST analysis; The competitive environment- Porter‘s Five Forces Framework, the value net, strategic groups hyper competition, Internal environment analysis- value-chain-analysis, evaluating Value chain, SWOT analysis; concept of internal environment, the resource-based view of strategy- resources, competencies, core competencies and distinctive capabilities; identifying sustainable competitive advantage, criticism of resource-based view, knowledge management, McKinsey's 7’s framework. **TB1: Ch 6.**

Module-4: Strategy Formulation **8 hours**

Concept, different perspectives on strategy formulation, concept and features of strategic planning. Business level strategy- Generic competitive strategies, a resource-based view to strategy formulation, the industry life-cycle; corporate level strategies- Growth strategies, related and unrelated diversification, implementing growth strategies,
External Growth Strategies: Mergers, Acquisitions, and Alliances,
Introduction and Objectives Mergers and Acquisitions: Causes and Consequences Strategic Alliances
TB1: Ch 8, TB2: Ch 15.

Module-5: Strategy Implementation **8 hours**

Concept, organizational structures- the entrepreneurial, functional, divisional, matrix and network, strategic leadership, leadership and management, the learning organization, leadership capabilities, impact of leadership on vision, values and culture, corporate culture and leadership, leading strategic change. **TB1: Ch 10.**

Course Outcomes: At the end of the course the student will be able to:	
22CBS564.1	Identify and analyze the nature of competition and industries at an advanced level
22CBS564.2	Examine external forces such as social, political/legal, economic, and technological influence strategic decision-making and firm performance.

22CBS564.3	Explain the sophisticated relationships among the functional areas of an organization and how effective strategic planning requires a concerted effort among all functional areas.
22CBS564.4	Inspect strategy research, including extensive use of the internet as a research tool.
22CBS564.5	Analyze higher order linear differential equations as linear homogeneous, linear non-homogeneous, with constant & variable coefficients and solve them.
22CBS564.6	Choose appropriate strategic management concepts to apply in the business world.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Strategic Management: Formulation, Implementation and Control	Pearce II, J.A., Robinson R.B and Mittal, A	McGraw Hill	12th Edition, 2017
2	Contemporary Strategic Management	Robert M. Grant	Blackwell	7th Edition, 2012
Reference Books				
1	Crafting and Executing Strategy	Thompson, A. Peteraf, M.A., Gamble, J.E., Strickland, A.J., and Jain A.K,	McGraw Hill	18th Edition 2011
2	Business Policy and Strategic Management	Kajmi, A.	Tata McGraw Hil	2008
3	Strategic Management and Business Policy	Wheelan, T.L. and Hunger J.D	Pearson	6th Edition, 1997

Web links and Video Lectures (e-Resources):

- https://www.mindtools.com/aqa3q37/pest-analysis
- https://thinkinsights.net/strategy/ge-mckinsey-matrix
- https://www.managementstudyguide.com/swot-analysis.htm

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS564.1	2	2												1
22CBS564.2		3			2									1
22CBS564.3					2		2							
22CBS564.4		2		3	2									
22CBS564.5				2	2		2							1
22CBS564.6					2	2		2						1

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**22RMI57**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE	3 Hours
Total Hours	25 hours	Credits	02

Course Learning Objectives:

1. To understand the basic concepts related to research
2. To learn the concept of literature survey, review and technical writing
3. To discuss the basics of intellectual property
4. To explain the patents, copyrights, trademarks, industrial designs and geographical indications

Module-1 Research Methodology and Literature Survey (5 hours)

Research Methodology: Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

Literature Survey, Literature Review: Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Chapter 1 , Textbook 2: Ch 7-9, 14-17.

Module-2 Technical Writing and Presentations (5 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and Objectives, Methodology, Time frame, Results and discussions, Conclusions. Illustrations.

Research Proposal Writing: Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Chapter 20-22, 26-28, 35.

Module-3 Introduction to IPR and Patents (5 hours)

Introduction to Intellectual Property: Types of IP, Role of IP in the economic and cultural development of the society, IP governance, IP as a global indicator of innovation, National IPR Policy in India. Textbook 3: Chapter 1,

Patents: Conditions for patent, Non-patentable matters, Inventions Eligible for Patenting**,** Salient features of the Indian Patent 1970**,** Process of patenting**,** Types of patent applications**,** Patent infringements**.** Case examples. Textbook 3: Chapter 2: 2.1.

Module-4 Copyright and Trademarks (5 hours)

Copyright: Classes of copyrights, Salient features of the Indian Copyright Act 1957, Criteria for copyright, Copyrights of the author, Copyright Infringements, Non-Copyright Work, Process of copyright registration. Copyright cases.

Trademark: Eligibility Criteria, Classification, Trade Mark Rules 2017, Advantages of registration, Types of trademark registered in India, Process for Trademarks Registration, Case examples.

Textbook 3: Chapter 2: 2.2 and 2.3.

Module-5 Industrial Designs and Geographical Indications (5 hours)

Industrial Designs: Introduction, Eligibility criteria, Famous industrial designs, Features of Design Act 2000, Non-Protectable industrial designs in India, Procedure for Registration of Industrial Designs, Case examples.

Geographical Indications (GIs): Introduction, Rights granted to holders, Popular GIs registered in India, salient features of Geographical Indications of Goods (Registration & Protection) Act, 1999, Non-Registerable GI, Procedure for GI Registration**,** Case examples.

Textbook 3: Chapter 2: 2.4 and 2.5.

Course Outcomes: At the end of the course the student will be able :	
22RMI57.1	To conduct literature survey, review and define a research problem.
22RMI57.2	To follow research ethics and develop the art of writing technical papers and reports.
22RMI57.3	To discuss the role of Intellectual Property and Patents in India.
22RMI57.4	To explain the various aspects of Copyright and Trademark in Indian context.
22RMI57.5	To explain legal aspects of Industrial Designs and Geographical Indications in India.
22RMI57.6	To discuss the case studies related to the different Intellectual Property.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Research Methodology: Methods and Techniques	C R Kothari and Gaurav Garg	New Age International Publishers	4th Edition 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4th Edition 2014
2	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018

Additional Resources: Web links/NPTEL Courses

https://ipindia.gov.in/ (Official website of Intellectual Property India)
https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy
https://www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf
https://corpbiz.io/learning/design-infringement-in-india/
https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))
https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22RMI57.1	-	2	-	-	1	-	-	-	-	-	-	2	-	-
22RMI57.2	-	-	-	-	1	-	-	3	-	2	-	-	-	-
22RMI57.3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.4	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.6	-	-	-	-	-	2	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	22ETP58	CIE Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	1	Exam Hours	03

Course Learning Objectives:

1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

Course Outcomes: At the end of the course the student will be able to:	
22ETP58.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
22ETP58.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
22ETP58.3	Apply RPA principles and tools to automate common tasks to boost productivity.
22ETP58.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
22ETP58.5	Explain the fundamentals of quantum computing and its real-world applications.
22ETP58.6	Develop a solution using emerging technologies for a real-world problem in teams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	Fourth Edition, 2020
2	Blockchain Technology	Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan	Universities Press (India) Pvt. Ltd.	First Edition 2020
3	Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology	Utpal Chakraborty	BPB Publications	First Edition, 2022
4	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath	Alok Mani Tripathi	Packt Publishing	First Edition 2018
5	Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity	Dr. Erdal Ozkaya	Packt Publishing Limited	First Edition 2019
6	Quantum Computing: A Gentle Introduction	Eleanor G. Rieffel, Wolfgang H. Polak.	MIT Press	First Edition 2014
Reference Books				
1	Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities	Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena	CRC Press	First Edition 2022
2	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress Berkeley, CA	2020
3	The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF)	Alan Calder	IT Governance Publishing	First Edition 2020

Web links/Video Lectures:

Introduction to Emerging Technologies:

1. https://aiethics.princeton.edu/case-studies/case-study-pdfs/
2. https://research.aimultiple.com/ai-ethics/
3. https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/
4. https://www.sciencedirect.com/science/article/pii/S0268401223000816
5. https://www.youtube.com/watch?v=G2fqAlgmoPo
6. https://www.youtube.com/watch?v=zizonToFXDs

Web 3.0: Blockchain and Metaverse

1. What is Ethereum? | ethereum.org
2. Navigating Remix — Remix - Ethereum IDE 1 documentation (remix-ide.readthedocs.io)

3. Solidity — Solidity 0.6.8 documentation (soliditylang.org)
4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s
5. The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan :: SSRN
6. Ethereum Smart Contract Best Practices (consensys.github.io)
7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

1. https://www.youtube.com/watch?v=nwFed03fS_s
2. https://www.youtube.com/watch?v=ScmK-bKJ4MI

RPA and Robotics:

1. https://www.youtube.com/watch?v=9URSbTOE4YI
2. https://www.youtube.com/watch?v=UEbw7dIOg0g
3. https://www.uipath.com/resources/automation-case-studies
4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

1. https://www.getastra.com/blog/security-audit/what-is-vapt/
2. https://owasp.org/www-project-top-ten/
3. https://owasp.org/www-project-mutillidae-ii/
4. https://www.youtube.com/watch?v=JAtwZoW76-I
5. Threat modelling (STRIDE framework): https://learn.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats
6. Cyber Kill Chain:https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html

Quantum Computing:

1. https://www.youtube.com/watch?v=e3fz3dqhN44
2. https://quantumai.google/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22ETP58.1	-	-	-	-		3	-	2	-	--	-	-
22ETP58.2	-	2	-	-	3	-	-	-		-	-	1
22ETP58.3	-	-	-	3	2	-	-	-	--	-	-	-
22ETP58.4	-	-	-	-	3	-		-	-	-	-	1
22ETP58.5	2	-	-	-	3	-	-	-	-	-	-	-
22ETP58.6	-	-	2	-	3	-	--	-	2	-	-	1

1: Low 2: Medium 3: High

VI Semester

Fundamentals of AI and ML			
Course Code	**22CBS61**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving.
- Define Machine Learning (ML) and its significance in AI.
- Understand the basics of Decision Tree and Introduce Reinforcement Learning (RL) and its components.
- Learn about Bayes' theorem and its application in concept learning.

Module-1 Introduction to AI **8 hours**

What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence, Intelligent Agents: Agents and Environments, Good Behavior: The concept of rationality, the nature of Environments, the structure of Agents.

TB1: Ch-1, 2

Module-2 Search Strategies **8 hours**

Problem solving agents, Example problems, Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic functions.

TB 1: Ch- 3

Module-3 Introduction to Machine Learning **8 hours**

Introduction: Machine learning Landscape: what is ML? Why, Types of ML, main challenges of ML. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm.

TB 2: Ch-1, 2

Module-4 Decision Trees and Reinforcement Learning **8 hours**

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm, Reinforcement Learning: Introduction, The learning task, Q-Learning.

TB 2: Ch- 3, 13

Module-5 Bayesian Learning **8 hours**

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, MDL principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, BBN, EM Algorithm.

TB 2: Ch-6

PRACTICAL MODULE

1. Write a Program to Implement simple Chatbot with minimum 10 conversations
2. Write a Program to Implement and Demonstrate Water Jug Problem.
3. Write a Program to Implement A* Algorithm.
4. Write a Program to Solve 8-Queens Problem with suitable assumptions.
5. Develop an interactive program to compare the working of FIND-S algorithm and LIST THEN ELIMINATE algorithm. Consider training data examples stored in Bitcoin_Prices dataset.
6. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.
7. Demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

8. Implement the naïve Bayesian classifier for a sample training data set stored as a NEET UG RESULTS DATASET.CSV file. Compute the accuracy of the classifier, considering few test data sets.

OPEN ENDED EXPERIMENT

Develop a machine learning model for classification task using a suitable dataset and evaluate its performance with various evaluation metrics.

Course Outcomes: At the end of the course, the student will be able to:	
22CBS61.1	Describe the fundamental concepts of Artificial Intelligence.
22CBS61.2	Demonstrate Various Search and Heuristic techniques.
22CBS61.3	Apply Machine Learning concepts and Implement Basic machine learning algorithms.
22CBS61.4	Apply decision tree and reinforcement learning technique for a given problem scenario.
22CBS61.5	Apply Bayesian Rule for a given problem scenario.
22CBS61.6	Analyze the techniques of AI & ML for specific applications.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Artificial Intelligence	Stuart J. Russell and Peter Norvig	Pearson Education	3rd Edition, 2015
2	Machine Learning	Tom Mitchell	McGraw Hill Publication	1st Edition, 2013
Reference Books				
1	Artificial Intelligence Structure and Strategies	George F Luger	Pearson Education	3rd Edition, 2000

Web links and Video Lectures(e-Resources):

- Artificial Intelligence - Overview (tutorialspoint.com)
- Problem-solving in Artificial Intelligence - TAE (tutorialandexample.com)
- Decision Tree Tutorials & Notes | Machine Learning | HackerEarth
- History of Artificial Intelligence - Javatpoint
- Heuristic Search Techniques in Artificial Intelligence - TechVidvan
- https://www.studocu.com/in/document/jawaharlal-nehru-technological-university hyderabad/machine-learning/machine-learning-lab-manual-part-1/55275690
- https://www.studocu.com/in/document/duquesne-university/computer-programming-c/6cs4-22- machine-learning-lab-manual/13932038
- https://intellipaat.com/blog/machine-learning-python-tutorial
- https://www.coursera.org/learn/machine-learning-with-python

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS61.1	1	2	2										1	
22CBS61.2		2											1	2
22CBS61.3		2			1								2	1
22CBS61.4		2			2								2	1
22CBS61.5	2	2	2		2								2	
22CBS61.6	2	2			1								2	

1: Low 2: Medium 3: High

Automata Theory and Compiler Design			
Course Code	**22CBS62**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory+10 lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Introduce core concepts in Automata Theory.
- Design Grammars and Recognizers for different formal languages.
- Understand the front end and back-end phases of Compiler.
- Familiar with LEX and YACC tools.
- Know the techniques in code generation.

Module-1 Introduction to Automata **8 hours**

Why study the Theory of Computation: Applications, **Languages and Strings:** Strings, Languages. **Finite State Machines (FSM)**: Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, **Regular Expressions (RE):** What is a RE?, Kleene's theorem

TB1: Ch 1, 2, 5, 6

Module-2 CFG and Turing Machines **8 hours**

Context-Free Grammars (CFG): Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, Derivation and Parse trees, Ambiguity.

Turing Machine: Turing machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction. Variants of Turing Machines.

TB1: Ch 11, TB3: Ch 4.2, TB2: Ch 9

Module-3 Front End of Compiler **8 hours**

Introduction: Language Processors, The structure of a compiler

Lexical Analysis: The role of lexical analyzer, Input buffering, Specifications of token, recognition of tokens, The Lexical Analyzer Generator Lex.

TB3: Ch 1, 3

Module-4 Syntax Analysis **8 hours**

Syntax Analysis: Introduction, writing Grammar, Top-down Parsing, Bottom-up Parsing, The parser Generator Yacc.

TB3: Ch 4

Module-5 Back End of Compiler **8 hours**

Syntax Directed Translation: Syntax Directed Definitions, Evaluation Orders for SDD's

Intermediate Code Generation: Variants of Syntax Trees, Three Address Code

Code Generation: Issues in the design of Code generator, The Target Language, The addresses in the Target Code, Basic Blocks and Flow Graphs

TB3: Ch 5, 6, 8

PRACTICAL MODULE

PART- A

1. Write a LEX program to recognize valid arithmetic expressions. Identifiers in the expression could be only integers and operators could be + and *. Count the identifiers & operators present and print them separately.
2. Write a LEX program to recognize and display keywords, numbers, and words in a given statement.
3. Write a LEX program to check whether a number is Prime or not.
4. Write a LEX program to eliminate comment lines in a C program and copy the resulting program into a separate file.
5. Write a YACC program to evaluate arithmetic expression involving operators: +, -, *, and /.

6. Design and Implement a YACC program to recognize all strings ending with *b* preceded by *n* number of *a*'s.
7. Write a YACC program to check whether a given string is Palindrome or not.
8. Write a YACC program which takes the following three-address code for the statement *A = -B * (C +D)* and generates the 8086 assembly language instructions.

T1 = -B
T2 = C + D
T3 = T1 + T2
A = T3

PART – B
OPEN ENDED EXPERIMENTS

1. Develop YACC/C program to construct Predictive / LL(1) Parsing Table for the following grammar rules. Use this table and demonstrate parsing of the sentence: *abba$*.

A →aBa
B →bB | ε

2. Develop YACC/C program to demonstrate Shift Reduce Parsing technique for the string *id + id * id* using the following grammar rules.

E →E+T | T
T →T*F | F
F → (E) | id

Course Outcomes: At the end of the course, the student will be able to:	
22CBS62.1	Apply the core concepts of automata theory for Finite State Machines.
22CBS62.2	Solve formal language problems by writing appropriate grammars and Turing Machines.
22CBS62.3	Apply basic steps of compilation process to show the different phases of translation for a given source language statement.
22CBS62.4	Construct Parsing Tables using appropriate parsing algorithms.
22CBS62.5	Analyze the back end of compilation process in generating target code.
22CBS62.6	Analyze the usage of Automata theory in Compilers using LEX and YACC tools.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Automata, computability, and Complexity	Elaine Rich	Pearson Education	1st Edition 2012 / 2013
2	Theory of Computer Science	K L P Mishra, N Chandrasekaran	Prentice Hall India Learning Pvt Ltd	3rd Edition, 2012
3	Compilers-Principles, Techniques and Tools	Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman	Pearson Publishers	2nd Edition, 2007
Reference Books				
1	Introduction to Automata Theory, Languages and Computation	J.P. Hopcroft, Rajeev Motwani, and J.D. Ullman	Pearson Education	3rd Edition, 2000

2	Formal Languages and Automata Theory	C K Nagpal	Oxford University press	1st Edition, 2012
3	Lex & Yacc	Doug Brown, John Levine, Tony Mason	O'Reilly Media	2nd Edition, 2012
4	Compiler Design 2013	K Muneeswaran	Oxford University Press	2nd Edition, 2013
5	Modern Compiler Design	Dick Grune, Kees Van,Henri, Koen L	Springer	2nd Edition, 2012

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/104/106104028/
- https://www.youtube.com/watch?v=Zs5XvkYm-9E
- **https://www.youtube.com/watch?v=2uf5Ph9NOS0**
- https://onlinecourses.nptel.ac.in/noc20_cs13/
- https://www.youtube.com/watch?v=5ZmFlxrNaN8&list=PLBlnK6fEyqRjT3oJxFXRgjPNzeS-LFY-q

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS62.1	2	2												1
22CBS62.2			2	2										2
22CBS62.3	2		2											
22CBS62.4		2	1											
22CBS62.5		2		1	2									
22CBS62.6				3	2									2

1: Low 2: Medium 3: High

Marketing Research and Marketing Management			
Course Code	**22CBS63**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Develop the student's basic analytical skills, conceptual abilities, and practical knowledge in marketing through lecture, discussions, and case studies
- To gain an understanding of marketing activities that connect people, brands, and businesses.
- Equip students with the key concepts and methods of marketing research.
- Learn the application of research tools to solve real-life business problems

Module-1: Introduction to Marketing Research **8 hours**

Marketing Research Dynamics- Introduction, Meaning of Marketing research, when marketing research is unnecessary, Nature and Scope of Marketing Research, Marketing Research in the 21st Century (Indian Scenario) Understanding the role of marketing research in decision-making. Exploring the different types of marketing research (qualitative and quantitative). Ethical considerations in marketing research. Case Study on Marketing Research Dynamics

TB1: Ch 1

Module-2: Research Design and Data Collection **8 hours**

Meaning and significance - Types: Exploratory and Conclusive Research Design. Formulating research objectives and hypotheses. Designing research methodologies (surveys, experiments, interviews, etc.). Sampling techniques and sample size determination. Data collection methods: online surveys, focus groups, observational research, etc. Data analysis techniques: quantitative analysis and qualitative analysis. Design and implementation of Marketing Research Projects.

TB1: Ch 6,12

Module-3: Data Analysis and Interpretation **8 hours**

Editing, Coding, Classification, Tabulation, Validation Analysis and Interpretation, Use of SPSS for coding, tabulating, and analysis of data- Report writing and presentation of results: Importance of report writing, types of research report, report structure, guidelines for effective documentation.

TB1: Ch 15, 20

Module-4: Marketing Management **8 hours**

Marketing V/s Selling, Customer value, Marketing Myopia. Marketing Environment - Components of Environment to be analyzed- Micro/ Macro Environment, Technological Environment, Sociocultural Environment, Economic Environment, Legal Environment, Consumer/Demographic Environment, Government policies, Political environment. Contemporary Indian Marketing Environment. Market Segmentation, Targeting & Positioning (STP). Understanding marketing mix. Product development and lifecycle management.

TB2: Ch 1,2

Module-5: Marketing Research Application **8 hours**

Applications of Marketing Research: Introduction, Consumer Market Research, Business-to-Business Market Research, Product Research, Product Adoption decisions, Pricing Research, Motivational Research, Distribution Research, Advertising Research, Media Research, Sales Analysis and Forecasting, Product prototypes, evaluating prototypes, Luxury and Lifestyle products. Case studies and practical examples of successful marketing research projects. Predictive analytics in marketing.

TB1: Ch 24

Course Outcomes: At the end of the course the student will be able to:	
22CBS63.1	Explain the significance and opportunities of marketing research in contemporary business environments
22CBS63.2	Comprehend the meaning and significance of various types of research designs, including exploratory and conclusive approaches.
22CBS63.3	Describe the different phases of data collection and importance of effective report writing
22CBS63.4	Compare various marketing environment in contributing to strategic marketing initiatives.
22CBS63.5	Differentiate various marketing application suitable for the model.
22CBS63.6	Solve real-life business problems by using the application of research tools

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Business Research Methods	S. N. Murthy & U. Bhojanna	Excel Books	3rd Edition, 2010
2	Marketing Management	Kotler, Keller, Koshy & Jha	Pearson Education	16th Edition, 2022
Reference Books				
1	Marketing in India: Text and Cases	Neelamegham S	Vikas	4th Edition, 2012
2	Market Research: Text and cases	Rajendra Nargundkar	Mc Graw Hill	3rd Edition, 2016

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=wuPqMenY56c
- https://www.youtube.com/watch?v=rXBH3YcOI6k
- http://www.icmrindia.org/Short%20Case%20Studies/Short%20Case%20Studies.asp?cat=Marketing%20Management
- http://www.ibscdc.org/marketing_case_studies.asp
- https://nptel.ac.in/courses/110107113/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS63.1	2				2				1			1		
22CBS63.2								2						
22CBS63.3			1			1		2					1	
22CBS63.4										2				
22CBS63.5					2								2	
22CBS63.6						2			2					1

1: Low 2: Medium 3: High

Enterprise Systems			
Course Code	**22CBS641**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the core concepts and components of enterprise systems.
- Analyze enterprise system architecture and database management.
- Develop skills in planning and implementing enterprise systems.
- Explore the role of enterprise systems in enhancing business relationships.

Module-1: Introduction to Enterprise System **8 hours**

Enterprise systems in Organizations: Information Silos and Systems Integration. **Enterprise Resource Planning Systems:** What Is an ERP? Evolution of ERP, Business Process and ERP, ERP System Components, ERP Architecture, e-Business and ERP, Benefits and Limitations of ERP. **Systems Integration:** Logical Vs. Physical SI, Steps in Integrating Systems, Benefits of System Integration, Limitations of System Integration. **ERP and Systems Integration:** ERP's Role in Logical Integration, ERP's Role in Physical Integration. **TB1: Ch1, 2**

Module-2: Enterprise System Architecture **8 hours**

ERP Architecture: Layered Architecture Example, Benefits and Limitations, Web Services Architectures, Service-Oriented Architectures, SOA and Web Services, Enterprise Content Management and SOA, Cloud Architecture. **ERP Implementation Life Cycle**: ERP Implementation Plan, ERP Implementation Methodology, Traditional ERP Life Cycle, Rapid ERP Life Cycles, ERP Life Cycle Vs. SDLC. **TB1: Ch3, 4**

Module-3: Implementation and Deployment of Enterprise system **8 hours**

ERP Components: Hardware**,** Software, People Resources**. ERP and Virtualization.** Third-Party Products**,** What Are They and Why Are They Needed? Impacts of Integration with ERP, Support Overcoming Third-Party Integration Issues, Middleware. **Database Requirements:** Understanding Transactional and Reporting Needs, Selecting the Database**,** Staffing and Database Administration. **Critical Success Factors**: Decision-Making Process, Project Scope, Teamwork, Change Management, Implementation Team and Executive Team. **TB1:Ch 5, 8**

Module-4: Business Relationships and Enterprise System **8 hours**

Business Process Change: Business Process Reengineering, BPR Methodology**,** Current BPR Tools. **Business Process Management:** Difference between BPR and BPM, Best Practices of BPM, BPM Software Vendors, Core Business Processes, Optimizing Business Processes, Benefits of Implementing BPM. **Outsourcing:** What Is Outsourcing? Outsourcing Drawbacks, Offshore Outsourcing, Software as a Service, Outsourcing Best Practices. **TB1:Ch9, 10**

Module-5: Supply Chain and Customer Relationship Management **8 hours**

Supply Chain Management: SCM Drivers, SCM Flows, SCM Processes. **e-Business and Supply Chain Management:** e-Procurement, Collaborative Design and Product Development, ERP System and Supply Chain. **Integration**: Supply Chain Integration, Integrating ERP and SCM Systems. **Customer Relationship Management:** What is CRM? Customer Relationship Processes, CRM Technology, CRM Life Cycle. **TB1:Ch 11, 12**

Course Outcomes: At the end of the course the student will be able to:	
22CBS641.1	Explain the fundamental concepts of enterprise systems, ERP, and systems integration.
22CBS641.2	Describe and explain ERP architectures and implementation methodologies.

22CBS641.3	Apply strategic planning techniques to implement and deploy enterprise systems effectively.
22CBS641.4	Demonstrate ERP, CRM, and SCM systems for optimizing business processes and enhancing organizational efficiency.
22CBS641.5	Analyze the impact of enterprise systems on business relationships with customers and suppliers
22CBS641.6	Compare emerging trends and technologies in enterprise systems for future business integration and innovation.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Enterprise Systems for Management	Luvai F. Motiwalla, Jeffrey Thompson	Prentice Hall	2nd Edition, 2021
Reference Books				
1	Enterprise System & Business Relationships	Peter Ekman	Malardalen University	1st Edition, 2006
2	Information and Enterprise Systems in Today's Businesses	Thomas Case & Michael Cuellar	KendalL Hunt Publishers	3rd Edition, 2020
3	Introduction to Business	Amit Shah, Carl McDaniel, and Lawrence J Gitman	12th Media Services	1st Edition, 2018
4	Enterprise Resource Planning	Vinod Kumar Grag and N.K. Venkitakrishnan	Prentice Hall of India	2nd Edition 2006

Web links and Video Lectures (e-Resources):

- https://youtu.be/JZTKRwHBkoM?si=qhTxRPSSgOvhc7al
- https://youtu.be/wo24YTZrCXg?si=BUBgYKQdsdogXMc-
- https://youtu.be/tnNNE_asoy8?si=aL4G5Q2nhDrVWIe7
- https://youtu.be/tnNNE_asoy8?si=cOIPrd9429Ql7Tas
- https://youtu.be/gfzdwTa82CM?si=-oKTolIsVDx7z_nt
- https://youtu.be/Da1hUqzoiAo?si=rsiCuMidQPkgPqsb
- https://youtu.be/9TVc32M_gIY?si=A7RTEve2RNvnCxu5
- https://youtu.be/-NMg6yFJrlQ?si=FXcSVsSbfvacp_Fi
- https://youtu.be/FLbNa4mfthQ?si=e5ujesLFbeFpGfJa
- https://youtu.be/_H59sWSG0eI?si=OLvZplVr-T0Pmwd1

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS641.1	2	1												
22CBS641.2		2												
22CBS641.3			2									2		
22CBS641.4			2	2										
22CBS641.5				2									1	
22CBS641.6				2						2		2	1	1

1: Low 2: Medium 3: High

Blockchain Technology			
Course Code	**22CBS642**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand basic of Blockchain Technology
- Explain Bitcoins and Alternative coins used in Blockchain
- Describe the idea of Ethereum Blockchain and Smart Contract
- Explore Solidity Programming language and Remix IDE to develop smart contract using Hyperledger fabric

Module-1: Introduction **8 hours**

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.
Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. **TB1: Ch 1, 2**

Module-2: Bitcoin **8 hours**

Bitcoin: Introduction to Bitcoin, Digital keys and Addresses, Transactions, Blockchain, Mining
Alternative Coins: Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash. **TB1: Ch 5, 8**

Module-3 : Smart Contracts & Ethereum **8 hours**

Smart Contracts: Definition, Ricardian contracts.
Ethereum 101: Introduction, Ethereum blockchain, Ethereum network, Elements of the Ethereum blockchain, Precompiled contracts. **TB1: Ch 9,10**

Module-4: Development Tools and Frameworks **8 hours**

Languages, Compilers, Solidity compiler (solc) Installation on Linux, Installation on macOS, Integrated Development Environments (IDEs), Tools and libraries, Ganache Meta Mask, Truffle Installation, Contract development and deployment.
Introducing solidity: Types, Value types, Literals, Enums, Function types, Reference types, Global variables, Control structures, Layout of a solidity source code file. **TB1: Ch 13**

Module-5: Hyperledger Fabric **8 hours**

Hyperledger Fabric: Building on the foundations of open computing, Fundamentals of the Hyperledger project, The Linux Foundation, Hyperledger, Open source and open standards, Hyperledger frameworks, tools, and building blocks, Hyperledger Fabric component design, Principles of Hyperledger design, Hyperledger Fabric reference architecture, Hyperledger Fabric runtime architecture, Strengths and advantages of componentized design
Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media Exploring. **TB1: Ch 17, TB2: Ch 2**

Course Outcomes: At the end of the course the student will be able to:	
22CBS642.1	Explain the fundamental building blocks of Blockchain technology.
22CBS642.2	Discuss the concepts of Bitcoin and their usage in various blockchain applications.
22CBS642.3	Use the concept of smart contracts and Ethereum and their application in various applications
22CBS642.4	Execute smart contract using Solidity, Remix IDE and Ethereum frameworks.
22CBS642.5	Analyze Hyperledger fabric including its framework, design principles and architecture
22CBS642.6	Develop block chain-based solutions by using the concepts learnt to solve real world problems.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained	Imran Bashir	Packt Publishing Ltd,	2nd Edition, 2017
2	Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna	Packt Publishing Ltd,	1st Edition, 2018
Reference Books				
1	Blockchain Technology (Concepts and applications),	Kumar saurabh, Ashutosh saxena,	Wiley, 2020	11th Edition 2010
2	Bitcoin and Cryptocurrency Technologies,	Arvind Narayanan, Joseph Bonneau, Edward	Princeton University Press	2016
3	Blockchain Basics: A Non-Technical Introduction in 25 Steps,	Daniel Drescher,	Apress	1st Edition, 2017
4	Mastering Bitcoin: Unlocking Digital Cryptocurrencies,	Andreas M. Antonopoulos,	O'Reilly Media	1st Edition, 2014

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105184/
- https://www.coursera.org/specializations/blockchain
- https://www.geeksforgeeks.org/blockchain/
- https://www.tutorialspoint.com/blockchain/index.htm
- https://www.youtube.com/watch?v=SyVMma1IkXM

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS642.1	2			1		1							1	
22CBS642.2		2		2	1			1						
22CBS642.3	1			2									2	
22CBS642.4			2		2			1						
22CBS642.5	2	1			2	1							2	
22CBS642.6			**1**	1				2						

1: Low 2: Medium 3: High

Human Resource Management			
Course Code	**22CBS643**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the role of HRMs in organizations and discuss major HRM activities.
- Provide reasoning as to why diversity is important to maintain profitability.
- Learn components of retention plan and strategies.
- Explain how to develop a performance review system, and explain health concerns that affect employees at work

Module-1: Introduction	**8 hours**
Evolution of HRM, Concept of HRM, Functions of HRM, Role and status of HRM, Human Resource Planning: Concept, Stages, long term and short-term HR plans, Strategies for dealing with manpower, HRIS.	
Module-2: Job Analysis and Recruitment	**8 hours**
Importance and benefits of job analysis, Job Analysis process, Job description, Job specification, other aspects of job, Recruitment: concept of recruitment, Factors affecting recruitment, sources of recruitment, metrics and alternatives.	
Module-3: Strategizing	**8 hours**
Planning and decision making, Levels of planning, Single use plans, standard plans, Contingency planning, Business level strategy, corporate level strategy, managing operations, Productivity and efficiency, configuring the production system, asset utilization, quality management, managing inventory.	
Module-4: Organization Architecture	**8 hours**
Designing structure, vertical and horizontal differentiation, integrating mechanisms, management challenges, control systems, methods of control, matching controls, Organizational culture, developing high performance teams, team design features and processes, managing team conflict.	
Module-5: Leading	**8 hours**
Staffing and developing a diverse workforce, recruiting and selecting job applicants, motivating and rewarding employee performance, managing employee attitudes and wellbeing, managing through power, negotiation and influence, effective leadership, communication.	

Course Outcomes: At the end of the course the student will be able to:	
22CBS643.1	Explain the evolution of Human Resource Management (HRM) and its significance in modern organizations.
22CBS643.2	Analyze the job analysis process, including the creation of job descriptions and job specifications.
22CBS643.3	Analyze different levels of planning, including single-use and standard plans, and their application in real-world scenarios.
22CBS643.4	Apply the principles of organizational culture and team design to develop high-performance teams.
22CBS643.5	Appraise the use of power, negotiation, and influence in effective leadership and communication within organizations.
22CBS643.6	Describe strategies for motivating and rewarding employee performance to enhance job satisfaction and productivity.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Human Resources Management	Dr W G Prasanna Kumar Dr K N Rekha	Tata McGraw Hill	1st Edition, 2021
2	Principles of Management	Charles W.L. Hill Steven L. McShane	Tata McGraw Hill	1st Edition, 2017
Reference Books				
1	Human resource Management	Dr. Arati Deepak kale, Anshita Chelawat, Trupti Shivram shelke	Himalaya Publishing House	1st Edition: 2018
2	Personnel / Human resource Management	Decenoz and robbins	Prentice Hall India	3rd Edition 2002

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=aPEUKLxxh_k
- https://www.youtube.com/watch?v=A2HFusWQIeE
- https://www.youtube.com/watch?v=vLIDpB2r5Cc
- https://www.youtube.com/watch?v=Jp7oM9mAIXQ
- https://www.youtube.com/watch?v=T7bSMzg7x-s

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS643.1									2		2		1	
22CBS643.2								1			2			
22CBS643.3								1			2		1	
22CBS643.4									1		2		2	
22CBS643.5									2		2			
22CBS643.6									1		2			

1: Low 2: Medium 3: High

Natural Language Processing			
Course Code	**22CBS644**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Introduce the fundamental concepts and techniques of natural language processing.
- Gain an in-depth understanding of the computational properties of natural languages
- Understand the commonly used algorithms for processing linguistic information.
- Examine NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Module-1: Introduction and Language Modelling **8 hours**

Introduction: What is NLP, Origins of NLP, Language and Knowledge, Challenges, Language & Grammar, Processing Indian Languages, NLP Applications

Language Modeling: Introduction, Grammar based Language Models-Generative Grammars, Statistical Language Model.

TB1: Ch 1, 2

Module-2: Word Level Analysis **8 hours**

Word Level Analysis: Introduction, Regular Expressions, Finite State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part- of-Speech Tagging. **TB1: Ch 3**

Module-3: Syntax Analysis **8 hours**

Syntactic Analysis: Context-Free Grammar, Constituency-Phrase level, Sentence level, Parsing-Top-down Parsing, Bottom-up Parsing, A Basic Top-Down Parser, Ambiguity in Parsing, The CYK Parser, Probabilistic Parsing, Indian Languages.

TB1: Ch 4

Module-4: Semantic Analysis and Discourse **8 hours**

Semantics Analysis: The representation of meaning, Syntax driven semantic analysis, Word Senses, Relations between senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation.

Computational Discourse: Discourse segmentation, Text Coherence Relations, Reference Resolution, Anaphora resolution.

TB1: Ch 19, 20.1, 21 TB2: Ch 5

Module-5: Applications **8 hours**

Applications: Machine Translation – Direct and Rule based MT, Information Retrieval-Design Features of IR systems, Classical IR models, Information Extraction, Automatic Text Summarization, Question Answering System.

TB2: Ch 8, 9, 11

Course Outcomes: At the end of the course the student will be able to:	
22CBS644.1	Discuss importance of NLP and the techniques used for language modeling in NLP
22CBS644.2	Discover the tools and techniques for Processing natural language texts at word and sentence level.
22CBS644.3	Analyze natural language texts for syntax.
22CBS644.4	Analyze natural language texts for semantics and pragmatics.
22CBS644.5	Examine real world applications involving natural language processing techniques

22CBS644.6	Create applications to carry out natural language processing.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Speech and Language processing: Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition.	Daniel Jurafsky, James H Martin	Pearson publications	3rd Edition, 2023
2	Natural Language Processing and Information Retrieval.	U.S. Tiwary, Tanveer Siddiqui	Oxford University Press	1st Edition 2008
Reference Books				
1	Corpus Linguistics	McEnery T., Wilson A.	Edinburgh University Press	2nd Edition, 1996
2	Information Storage and Retrieval systems – Theory and Implementation	Gerald J. Kowalski and Mark. T. Maybury	Kluwer academic Publishers	2nd Edition, 2006

Web links and Video Lectures (e-Resources):

- https://scikitlearn.org/stable/tutorial/text_analytics/working_with_text_data.html
- https://nptel.ac.in/courses/106101007
- https://onlinecourses.nptel.ac.in/noc19_cs56/preview
- https://www.youtube.com/watch?v=3_oCVemqzFo
- https://www.youtube.com/playlist?list=PLEuhkeqNvDnJ00VSJsv9VuRnIocxGs_DB

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS644.1			2											
22CBS644.2				2	2									
22CBS644.3		2	2											
22CBS644.4		2	2											
22CBS644.5		2	2											
22CBS644.6					2								1	

1: Low 2: Medium 3: High

Introduction to AI and ML			
Course Code	**22CBS651**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Gain the historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving.
- Understand the basics of Machine Learning with the basics of Concept learning.
- Apply the basics of Similarity-Based learning and Decision Tree learning.
- Apply the basics of Bayesian learning and Artificial Neural Networks.

Module-1: Introduction to AI **8 hours**

What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence, Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.

TB1: Ch 1, 2

Module-2: Problem Solving by Searching **8 hours**

Problem solving agents, Example problems, Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic functions

TB 1: Ch 3

Module-3: Introduction to ML **8 hours**

Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.

Basics of Learning Theory: Introduction to learning and its types, Introduction computational learning theory, Design of learning system, Introduction concept learning.

TB 2: Ch 1, 3

Module-4: Decision Tree Learning **8 hours**

Similarity-based learning: Introduction to Similarity or instance based learning, Nearest neighbor learning, weighted k- Nearest - Neighbour algorithm.

Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validating and Pruning of Decision Trees.

TB 2: Ch 4 , 6

Module-5: Bayesian Learning & ANN **8 hours**

Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model.

Artificial Neural Networks: Introduction, Artificial Neurons, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of Artificial Neural Networks.

TB 2: Ch 8, 10

Course Outcomes: At the end of the course the student will be able to:	
22CBS651 .1	Describe the fundamentals of AI.
22CBS651 .2	Demonstrate searching and problem-solving techniques.
22CBS651 .3	Identify the need for machine learning tasks for solving various problems.
22CBS651 .4	Choose Similarity Based and Decision Tree Learning for various tasks.

22CBS651 .5	Apply Baye's algorithm for classification task and comprehend ANN learning and its applications.
22CBS651 .6	Analyze AI concepts, problem-solving techniques, Machine Learning algorithms, and Decision Tree Learning methods and ANNs to real-world problems and scenarios.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1.	Artificial Intelligence	Stuart J. Russell and Peter Norvig	Pearson Education	3rd Edition, 2015
2	Machine Learning	S. Sridhar, M Vijayalakshmi	Oxford	2021
Reference Books				
1	Artificial Intelligence Structure and Strategies.	George F Luger	Pearson Education	3rd Edition, 2000
2	Machine Learning	Tom Mitchell	McGraw Hill Publication	2013

Web links and Video Lectures (e-Resources):

- Artificial Intelligence - Overview (tutorialspoint.com)
- Problem-solving in Artificial Intelligence - TAE (tutorialandexample.com)
- Decision Tree Tutorials & Notes | Machine Learning | HackerEarth
- History of Artificial Intelligence - Javatpoint
- Heuristic Search Techniques in Artificial Intelligence - TechVidvan

Course Articulation Matrix

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
22CBS651 .1	1												1	
22CBS651 .2		2	2										2	
22CBS651 .3	1		2										1	
22CBS651 .4		2	2										2	
22CBS651 .5	1		2										1	
22CBS651 .6			2											

1: Low 2: Medium 3: High

Business Strategy			
Course Code	**22CBS652**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the strategic management, analyzing and evaluating its application in the business world.
- Explore the objectives and strategy for business
- Explain the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology.
- Analyze complex, unstructured qualitative and quantitative problems.

Module-1: Introduction **8 hours**

Introduction: Concept and importance of strategic management, importance of strategic decisions, elements of strategic management, Need for strategy, levels of strategy, strategic management process, changes in the approach to strategic management.

TB1

Module-2: Vision and Mission, Objectives and Strategy **8 hours**

Developing strategic vision, communicating the strategic vision, crafting a mission statement, linking vision and mission with company values, levels of objectives, crafting objectives.

Sources of Sustained Competitive Advantage: Introduction and Objectives, How Competitive Advantage Emerges and Is Sustained, Types of Competitive Advantage: Cost and Differentiation.

TB1, TB2

Module-3: Strategic Analysis **8 hours**

Concept, the general environment; scanning, monitoring and forecasting the environment, Scenario planning, PEST analysis; The competitive environment- Porter‘s Five Forces Framework, the value net, strategic groups hypercompetition, Internal environment analysis- value-chain-analysis, evaluating Value chain, SWOT analysis; concept of internal environment, the resource-based view of strategy- resources, competencies, core competencies and distinctive capabilities; identifying sustainable competitive advantage, criticism of resource-based view, knowledge management, McKinsey's 7’s framework.

TB1

Module-4: Strategy Formulation **8 hours**

Concept, different perspectives on strategy formulation, concept and features of strategic planning. Business level strategy- Generic competitive strategies, a resource-based view to strategy formulation, the industry life-cycle; corporate level strategies- Growth strategies, related and unrelated diversification, implementing growth strategies, External Growth Strategies: Mergers, Acquisitions, and Alliances,

Introduction and Objectives Mergers and Acquisitions: Causes and Consequences Strategic Alliances.

TB1, TB2

Module-5: Strategy Implementation **8 hours**

Concept, organizational structures- the entrepreneurial, functional, divisional, matrix and network, strategic leadership, leadership and management, the learning organization, leadership capabilities, impact of leadership on vision, values and culture, corporate culture and leadership, leading strategic change.

TB1

Course Outcomes: At the end of the course the student will be able to:	
22CBS652.1	Learn and analyze the nature of competition and industries at an advanced level.

22CBS652.2	Understand how external forces such as social, political/legal, economic, and technological influence strategic decision-making and firm performance.
22CBS652.3	Understand the sophisticated relationships among the functional areas of an organization and how effective strategic planning requires a concerted effort among all functional areas.
22CBS652.4	Understand strategy research, including extensive use of the internet as a research tool.
22CBS652.5	Analyze higher order linear differential equations as linear homogeneous, linear non-homogeneous, with constant & variable coefficients and solve them.
22CBS652.6	Choose appropriate strategic management concepts to apply in the business world.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Strategic Management: Formulation, Implementation and Control	Pearce II, J.A., Robinson R.B and Mittal, A	McGraw Hill.	12th Edition, 2017
2	Contemporary Strategic Management	Robert M. Grant	Blackwell	7th Edition, 2012
Reference Books				
1	Crafting and Executing Strategy	Thompson, A. Peteraf, M.A., Gamble, J.E., Strickland, A.J., and Jain A.K,	McGraw Hill -	18th Edition, 2011
2	Business Policy and Strategic Management	Kajmi, A.	Tata McGraw Hil	2008
3	Strategic Management and Business Policy	Wheelan, T.L. and Hunger J.D	Pearson	6th Edition, 1997

Web links and Video Lectures (e-Resources):

- https://www.mindtools.com/aqa3q37/pest-analysis
- https://thinkinsights.net/strategy/ge-mckinsey-matrix
- https://www.managementstudyguide.com/swot-analysis.htm

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS652.1	2	2												1
22CBS652.2		3			2									1
22CBS652.3					2		2							
22CBS652.4		2		3	2									
22CBS652.5				2	2		2							1
22CBS652.6					2	2		2						1

1: Low 2: Medium 3: High

Introduction to Computer Vision			
Course Code	**22CBS653**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn basic principles of image formation, image processing algorithms.
- Understand the core vision tasks of scene understanding and recognition.
- Choose the appropriate segmentation and clustering techniques for vision modeling.
- Apply different vision levels for image/video analysis, object recognition in building a computer vision model.

Module-1: Introduction to Computer Vision **8 hours**

Overview of computer vision and its applications: Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation

TB1: Ch-1.1 to 1.3

Module-2: Image Processing **8 hours**

Image Processing: Pixel transforms, color transforms, histogram processing, histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening, blurring and noise removal.

TB2: Ch 3 - 3.2 to 3.6 and Ch 4 - 4.2, 4.5 to 4.10

Module-3: Object recognition and Feature detection **8 hours**

Object recognition and shape representation: alignment, appearance-based methods, invariants, image eigenspaces Feature detection: edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations.

TB1: Ch -17, Ch -18

Module-4: Segmentation **8 hours**

Segmentation: Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized cut.

TB1: Ch -9.2, 9.4, 9.5

Module-5: Image Registration **8 hours**

Registration: Registering Rigid Objects, with Projection, Registering Deformable Objects. Smooth Surface and their Outlines: Elements of Differential Geometry, Contour Geometry.

TB1: Ch 12.1 to 12.3

Course Outcomes: At the end of the course the student will be able to:	
22CBS653 .1	Describe the fundamental image processing techniques required for computer vision
22CBS653 .2	Explain Image formation process.
22CBS653 .3	Identify appropriate object recognition and shape analysis techniques.
22CBS653 .4	Compare different segmentation techniques.
22CBS653 .5	Make use of image registration techniques.
22CBS653 .6	Analyze the use of computer vision techniques in real-life applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Computer Vision – A modern approach	D. Forsyth and J. Ponce	Prentice Hall	2nd Edition, 2012
2	Digital Image Processing	Rafael C. Gonzalez and Richard E. Woods	Prentice Hall	4th Edition 2018
Reference Books				
1	Computer Vision: Models, Learning, and Inference	Simon J. D. Prince	Cambridge University Press	1st Edition 2012
2	Building Computer Vision Applications Using Artificial Neural Networks - With Step-by-step Examples in Opencv And Tensorflow With Python	Shamshad Ansari	Apress	1st Edition, 2020

Web links and Video Lectures (e-Resources):

- https://youtu.be/V_xro1bcAuA?si=otfZ_1VYInB6tz1W
- https://www.udacity.com/course/introduction-to-computer-vision--ud810
- https://www.mygreatlearning.com/academy/learn-for-free/courses/computer-vision-essentials
- https://www.mltut.com/best-free-computer-vision-courses/
- https://www.youtube.com/watch?v=D5hmApvpLH4
- https://www.youtube.com/watch?v=01sAkU_NvOY

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS653 .1	2											2		2
22CBS653 .2		2	2										2	
22CBS653 .3						2						2		
22CBS653 .4		2	2	2	2	1	2	1						
22CBS653 .5				1	2	1			1	2	2			
22CBS653 .6			1		1				2	2	2			2

1: Low 2: Medium 3: High

Predictive Analytics			
Course Code	**22CBS654**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is

- Learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
- Know the use of the binary classifier and numeric predictor nodes to automate model selection.
- Be familiar when and how to use each model and Learn how to combine two or more models to improve prediction.
- Understand how analytics provided a solution to industries using real case studies.

Module-1: Linear Regression and Classification **8 hours**

Overview of Supervised Learning, what is statistical learning, Linear Methods for Regression, Simple Linear regression, Multiple Linear Regression, Multiple outputs, Other Considerations in the Regression Model, Logistic Regression, Linear Discriminant Analysis, A Comparison of Classification Methods. **TB1: Ch 2, 3 ; TB2: Ch 1, 3, 4.**

Module-2: Model Assessment and Selection **8 hours**

Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, conditional or expected test error. Resampling Methods: Cross-Validation, The Bootstrap, Subset Selection, Shrinkage Methods.
TB1 Ch 7, TB2 Ch 5, 6.

Module-3: Additive Models, Trees and Boosting **8 hours**

Generalized additive models, Tree-Based Methods, MARS: Multivariate Adaptive Regression Splines, Hierarchical Mixtures of Experts, Boosting Methods, The Basics of Decision Trees, Boosting Trees, Numerical Optimization via Gradient Boosting, Regularization, Right-Sized Trees for Boosting, Bagging, Random Forests, Boosting. **TB1: Ch 9, TB2:Ch 8.**

Module-4: Neural Networks (NN), Support Vector Machines (SVM), and K-nearest Neighbor **8 hours**

Fitting neural networks, Back propagation, Issues in training NN, The Support Vector Classifiers, SVM and kernels, Support Vector Machines, SVMs with More than Two Classes, Relationship to Logistic Regression, Flexible Discriminant Analysis, Penalized Discriminant Analysis, Mixture Discriminant Analysis. **TB1: Ch 11, 12, TB2: Ch 9.**

Module-5: Unsupervised Learning and Random forests **8 hours**

Association rules, Cluster analysis, Principal Components, Definition of Random Forests, Random forests and analysis. Clustering Methods, NCI60 Data Example, Independent Component Analysis, Learning Ensembles. Markov Graphs and Their Properties.
TB1: Ch 14,15,16; TB2: Ch 10.

Course Outcomes: At the end of the course the student will be able to:	
22CBS654.1	Demonstrate the process of formulating business objectives, data selection/collection, preparation and process for a various business application.
22CBS654.2	Compare the underlying predictive modeling techniques.
22CBS654.3	Select appropriate predictive modeling approaches to identify cases to progress with.

22CBS654.4	Apply predictive modeling approaches using a suitable package such as SPSS Modeler.
22CBS654.5	Choose data and identify relationships among variables.
22CBS654.6	Analyze the performance of the models with holdout data and apply predictive models to generate predictions for new data.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	The Elements of Statistical Learning-Data Mining, Inference, and Prediction	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer Verlag	2nd Edition, 2009
2	An introduction to statistical learning with applications in R	G.James,D.Witten,T. Hastie,R.Tibshirani	Springer	1st Edition, 2013
Reference Books				
1	Pattern Recognition and Machine Learning	C.M.Bishop	Springer	2006
2	All of statistics	L.Wasserman	Springer	2004th Edition
3	Predictive & Advanced Analytics		(IBM ICE Publication)	

Web links and Video Lectures (e-Resources):

- https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics
- https://www.youtube.com/watch?v=Kd0C-8q0HkI
- https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-into-future-insights.html
- https://www.conestogac.on.ca/fulltime/predictive-analytics
- https://www.youtube.com/watch?v=Cx8Xie5042M
- https://www.youtube.com/watch?v=1xw915rbyG4

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CBS654.1	1												1	
22CBS654.2	2	1		1										
22CBS654.3	1	2		1									2	1
22CBS654.4													2	1
22CBS654.5	1	3	2		3								1	2
22CBS654.6		1	1					1	1	2				1

1: Low 2: Medium 3: High

Major Project Phase I			
Course Code	**22CBS66**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:4)	SEE	-
Total Hours	48 hours	Credits	02

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Report Submission

- **Report**: The project report should include an abstract, introduction, literature review, methodology, completed portion of the project work with the available results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the project report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. **Mentorship and Feedback**

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 100 marks)**
1. Project Synopsis Evaluation	Beginning of the 6th Semester	20 marks
2. Project Progress Evaluation	Middle of the 6th Semester	30 marks
3. Project Report Evaluation (Phase I)	End of the 6th Semester	50 marks
Marks given for the Project Report shall be the same for all project team members, However, marks may differ for presentations and viva-voce depending upon the individual student performance.		
Semester End Examinations (SEE)		
4. There is No SEE component for Major Project Phase I.		

Course Outcomes: At the end of the course the student will be able to :	
22CBS66.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
22CBS66.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
22CBS66.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
22CBS66.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
22CBS66.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.

22CBS66.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CBS66.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
22CBS66.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
22CBS66.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
22CBS66.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
22CBS66.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
22CBS66.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**22CIV67**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:0	SEE	2 Hours
Total Hours	15 hours	Credits	01

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology (3 hours)

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic, and Lake. Biodiversity: Types, Value; Hot spots; Threats and Conservation of Biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources (3 hours)

Advances in Energy Systems (Merits, Demerits, Global Status, and Applications): Hydrogen, Solar, OTEC, Tidal, and Wind.
Natural Resource Management (Concept and case studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health (3 hours)

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution, and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns (3 hours)

Global Environmental Concerns (Concept, policies, and case studies): Groundwater depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problems in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management (3 hours)

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Fieldwork: A visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; thought to be Followed by an understanding of the process and its brief documentation (Optional).

Course Outcomes: At the end of the course the student will be able to:	
22CIV67.1	Identify the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
22CIV67.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
22CIV67.3	Demonstrate ecology knowledge of a complex relationship between a biotic and abiotic component.
22CIV67.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
22CIV67.5	Address problems related to waste management and public health aspects
22CIV67.6	List the Standards and latest tools to mitigate pollution.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Environmental studies	Benny Joseph	Tata McGraw-Hill	Edition 3, 2018
2	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	Edition 3, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	Dhanpat Rai Publishing Co. (P) Ltd	2017
2	Text book of Environmental Studies for Undergraduate Courses	Bharucha Erach	Universities Press	Edition 2, 2017
3	Environmental Studies	Ranjit R. J Daniels, Jagdish Krishnaswamy	John Wiley & Sons Inc.	2010
4	Perspective in Environmental Studies	Anubha Kaushik, C P Kaushik	New Age International Pvt. Ltd	Edition 3, 2009

Web links and Video Lectures (e-Resources):

1. **Coursera Course: Introduction to Environmental Science Specialization -** https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
2. **NPTEL: Environmental Studies -** https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
3. **Directory of Open Access Books (DOAB) - Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : http://link.springer.com/openurl?genre=book&isbn=978-4-431- 54339-8**
4. **Lec 31: Environmental Management Systems (EMS) - https://youtu.be/BYqLRGawoH0**
5. **ISO 14001:2015 Training - Environmental Management - https://youtu.be/2f4pBIvXkBs**

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CIV67.1	-	-	-	-	-	1	3	-	-	-	-	-	-	-
22CIV67.2	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.3	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.4	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-
22CIV67.6	-	-	-	-	1	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**22IIP68**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	20 Hrs	Credits	01

Course Learning Objectives:

1. Learn how to use online databases and search tools for conducting patent searches.
2. Develop skills in analyzing patent documents and identifying relevant prior art.
3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
4. Understand the principles of technology gap analysis and patentability search.
5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.
Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.
Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.
Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process
Activity: Prepare a Patent Draft for the Proposed Capstone Project.

Course Outcomes: At the end of the course, the student will be able to:	
22IIP68.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
22IIP68.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
22IIP68.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.
22IIP68.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
22IIP68.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
22IIP68.6	Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent

	applications, to solve real-world problems and challenges in the field of intellectual property rights.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books/Sources				
1	Intellectual Property-A Primer for Academia (For Module 1)	Rupinder Tewari Mamtha Bhardway	Publication Bureau, Panjab University Chandigarh India	2021
2	Patent Landscape Reports (For Module 2)	WIPO - World Intellectual Property Organization https://www.wipo.int/patentscope/en/programs/patent_landscapes		
3	Guidelines for Preparing Patent Landscape Reports (For Module 2)	Anthony Trippe, Patinformatics, LLC	World Intellectual Property Organization (WIPO)	2015
4	Patent Searching - Tools and Techniques (For Module 3)	David Hunt	John Wiley & Sons Inc	First Edition 2007
5	The Complete Patent Book_ Everything You Need to Obtain Your Patent (For Module 4)	James L. Rogers	Sphinx Publishing	First Edition 2003

Additional Resources:

1. WIPO Patent Drafting Manual - Second Edition 2023, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf
2. Patent Drafting for Beginners - https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed
3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India - https://www.ipindia.gov.in/
4. Copyright Office, Government of India - https://copyright.gov.in/
5. United States Patent and Trademark Office - https://www.uspto.gov/
6. Espacenet – patent search - https://worldwide.espacenet.com/
7. The Lens - Free & Open Patent and Scholarly Search - https://www.lens.org/
8. WIPO PATENTSCOPE - https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22IIP68.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
22IIP68.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
22IIP68.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
22IIP68.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
22IIP68.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
22IIP68.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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