BE SCHEME & SYLLABUS

Third Year
(V and VI Semester)

With effect from 2022-23

Computer Science & Engineering (Data Science)

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), MBA and MCA
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS

(With effect from 2022-23)

Computer Science & Engineering (Data Science)

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 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

Computer Science and Data Science are two interrelated fields that have become increasingly important in today's digital age. While Computer Science focuses on the study of computers and computational systems, Data Science is concerned with the extraction, analysis, and interpretation of complex data sets. Data Science has emerged with the growth of data and involves collecting, cleaning, and analysing large data sets using statistical techniques and machine learning algorithms to identify patterns and trends for better decision-making.

Combining Computer Science and Data Science (CSDS) will play an essential role in the digital age. As more and more data are generated, the demand for skilled professionals in these fields is only going to increase. As a result, students and professionals need to gain knowledge and skills in both Computer Science and Data Science to stay competitive in today's job market such as Business Intelligence Developers, Research Scientists, Big Data Engineer/ Architect, Software Engineer, Data Analyst, Data Scientist, Data Mining & Analysis, NLP Engineer, AI Engineer, Cyber Analyst, and Product manager that are highly demanding. Demand for data science engineers is expected to grow to 27.9% by 2026.

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. - CSDS)													
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	22CDS51	Software Engineering and Project Management	CSDS	CSDS	3	-	-	03	50	50	100	3
2	IPCC	22CDS52	Computer Networks (Integrated)	CSDS	CSDS	3	-	2	03	50	50	100	4
3	IPCC	22CDS53	Fundamentals of AI and ML (Integrated)	CSDS	CSDS	3	-	2	03	50	50	100	4
4	PCC	22CDS54	Principles of Data Science	CSDS	CSDS	2	2	-	03	50	50	100	3
5	PCCL	22CDS55L	Data Visualization Laboratory	CSDS	CSDS	-	-	2	03	50	50	100	1
6	PEC	22CDS56X	Professional Elective - I	CSDS	CSDS	3	-	-	03	50	50	100	3
7	AEC/SDC	22RMI57	Research Methodology and Intellectual Property Rights	COM	COM	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**

22CDS56X : Professional Elective I			
22CDS561	Data Compression Techniques	22CDS563	Natural Language Processing
22CDS562	Human Computer Interaction	22CDS564	Business Intelligence

VI Semester (B.E. - CSDS)													
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	22CDS61	Digital Image Processing (Integrated)	CSDS	CSDS	3	-	2	03	50	50	100	4
2	IPCC	22CDS62	Automata Theory and Compiler Design (Integrated)	CSDS	CSDS	3	-	2	03	50	50	100	4
3	PCC	22CDS63	Data Security and Privacy	CSDS	CSDS	3	-	-	03	50	50	100	3
4	PEC	22CDS64X	Professional Elective -II	CSDS	CSDS	3	-	-	03	50	50	100	3
5	OEC	22XXX65X	Open Elective -I	CSDS	CSDS	3	-	-	03	50	50	100	3
6	PRJ	22CDS66	Major Project Phase - I	CSDS	CSDS	-	-	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**

22CDS64X : Professional Elective II			
22CDS641	Full Stack Development	22CDS643	Deep Learning and Neural Networks
22CDS642	Blockchain Technology	22CDS644	Industrial and Medical IoT

22CDS65X : Open Elective I			
22CDS651	Introduction to AI and ML	22CDS653	Introduction to Computer Vision
22CDS652	Introduction to Data Science	22CDS654	Predictive Analytics

V Semester

Software Engineering and Project Management			
Course Code	**22CDS51**	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 software project management.
- To have a good knowledge of responsibilities of project manager.
- To be familiar with the different methods and techniques used for project management.
- Implement a software project management activity and complete a specific project in time with the available budget.

Module-1: Introduction (8 hours)

Introduction: Defining of Software Development Process - Process – Software engineering ethics, Software Process Models: Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Component Assembly Model - Software Life Cycle, Process activities, coping with change**.**

TB1: Ch- 1, 2

Module-2 : Software Development (8 hours)

Agile Software Development: Agile methods, Agile project management, scaling agile methods. Requirements engineering: Functional and non-functional requirements. Requirements specification, validation, management. System modelling: models, model driven engineering, Architectural design: views, patterns, architectures.

TB1: Ch- 3, 4, 5, 6

Module-3 : Software Design, Implementation, Testing and Evolution (8 hours)

Design and Implementation: Object-oriented design using the UML, Design patterns, Implementation issues, Open-source development.

Software Testing: Development testing, Test-driven development, Release Testing, User Testing

Testing: Testing concepts, Testing process**,** Black-Box Testing, White-Box Testing, Metrics

TB1: Ch- 7, 8 TB2: Ch- 8

Module-4 : Project management, planning, tracking and reporting (8 hours)

Project management: Risk Management, Managing people, Teamwork

Project Planning: Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation Techniques, COCOMO cost modelling

Project tracking and reporting: Introduction, Project Execution, Monitoring and Controlling Project Work, Project Performance Reports.

TB1: Ch- 20, 23 TB3: Ch- 19

Module-5 : Project quality, configuration management and closure (8 hours)

Quality Management: Software quality, Software standards, Reviews and inspections, Quality Management and agile development, Software measurement.

Configuration Management: Version management, System building, Change management, Release Management.

Project Closure: Introduction, Why? Acceptance Closure, Major activities in Close Project, Administrative and Contract closure, Project closure process, Project Termination, Closure Analysis, Final closure report.

TB1: Ch- 24, 25 TB3: Ch- 20

Course Outcomes: At the end of the course the student will be able to:	
22CDS51.1	Apply project management concepts and techniques to an IT project

22CDS51.2	Identify issues that could lead to IT project success or failure
22CDS51.3	Explain project management in terms of the software development process
22CDS51.4	Describe the responsibilities of IT project managers.
22CDS51.5	Apply project management concepts through working in a group as team leader
22CDS51.6	Determine an appropriate project management approach through an evaluation of the business context and scope of the project.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Software Engineering	Ian Sommerville	Pearson	9th Edition, 2017
2	Software Engineering A Precise Approach	Pankaj Jalote	Wiley India	1st Edition, 2024
3	Software Project Management	Saikat Dutt /S. Chandramouli	Pearson	1st Edition, 2015
Reference Books				
1	Software Engineering	Roger S Pressman	McGraw Hill Publication.	7th Edition, 2013
2	Managing Information Technology Project	Kathy Schwalbe	Cengage Learning Publication.	7th Edition, 2024
3	Software Engineering Project Management	Richard H. Thayer	Wiley India Publication.	2nd Edition, 2015

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/playlist?list=PLYwpaL_SFmcCB7zUM0YSDR-1mM4KoiyLM
- https://www.youtube.com/watch?v=w9BSk8MGOGM
- https://www.youtube.com/watch?v=bXLTxa7wBO0
- https://www.youtube.com/watch?v=0RmBrKxwCz8
- https://www.coursera.org/lecture/software-engineering-software-design-and-project-management/lecture-6-1-project-management-3fFjd
- https://www.youtube.com/watch?v=zem9u4-99RM
- https://www.youtube.com/watch?v=PnDqi7ISdOQ

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS51.1	3				2								2	1
22CDS51.2			3				2							
22CDS51.3		1	2			1	2							
22CDS51.4							1			1				
22CDS51.5			3	1						2			2	1
22CDS51.6								1	1				2	1

1: Low 2: Medium 3: High

Computer Networks			
Course Code	**22CDS52**	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 **8 hours**

Uses of computer networks: Business Applications, Home Application, Mobile Users, Social Issues; Network hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks, Home Networks, Internet works; Network software: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connection-less Services, Service Primitives. Reference Models: OSI Reference Model and TCP/IP Reference Model.
TB1

Module-2: Physical Layer & Data Link Layer **8 hours**

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.
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.
TB2

Module-3: Network Layer **8 hours**

Routing algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link state Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Ad hoc Networks. Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies The Network Layer in the Internet: The IPv4 Protocol, IP Addresses, subnets, CIDR-Classless Inter Domain Routing, Mobile IP, IPv6, IPv6 Header.
TB1

Module-4: Transport Layer **8 hours**

Introduction: Transport-Layer Services, Connectionless and Connection-Oriented Protocols, User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol, TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control
TB2

Module-5: Application Layer **8 hours**

Introduction, Client-Server Programming using TCP and UDP, World Wide Web, Hyper Text Transfer Protocol (HTTP), FTP, Electronic Mail, Domain Name System (DNS): Name Space, DNS in the Internet, Resolution, Caching, Resource Records, DNS Messages
TB2

PRACTICAL MODULE

1. Network System Administration: Understanding the basic network configuration and installation.
2. Implement a Python Program to print host name and IP address of local host.
3. Implement a Python Program to print host name and IP address of remote host where IP address of remote host is available.
4. 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.
5. 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.
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 for error detection code using CRC-CCITT(16 bits).
8. Write a program in Java/Python to implement congestion control using Leaky Bucket algorithm.

OPEN ENDED EXPERIMENT

1. Perform Network Analysis using Packet Tracer/Wireshark tool.
2. Implement packet sniffer using any programming language.

Course Outcomes: At the end of the course the student will be able to:	
22CDS52.1	Explain the fundamental principles involved in data communication
22CDS52.2	Describe the fundamental concepts involved in physical layer, different switching mechanisms and data link layer protocols for digital communication
22CDS52.3	Discuss routing protocols, cellular network operations, and the development of policies and protocols.
22CDS52.4	Identify the essential principles of a transport layer protocol and explain how they are used to solve computer networking problems.
22CDS52.5	Apply the basic concepts of networking to explain the principles of application layer protocols and select appropriate protocols for a particular scenario
22CDS52.6	Analyze the current architecture of the internet and the entities involved in the day to day running of the internet using modern networking tools.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Computer Networks	Andrew S. Tanenbaum David J. Wetherall	Pearson	6th Edition, 2021
2	Data Communications and Networking	Behrouz A. Forouzan	Tata McGraw-Hill	6th Edition, 2022
Reference Books				
1	Computer Networking, A Top-Down Approach	James F Kurose and Keith W Ross	Pearson	6th Edition, 2017

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):

- Computer Networks and Internet Protocol, IIT Kharagpur: https://www.youtube.com/playlist?list=PLbRMhDVUMngf-peFloB7kyiA40EptH1up
- TCP/IP Tutorial and Technical Overview: https://www.redbooks.ibm.com/redbooks/pdfs/gg243376.pdf
- RFCs: http://www.ietf.org/rfc.html
- Computer Networks: https://www.cse.iitk.ac.in/users/dheeraj/cs425/
- Web Resources for Computer Networks, 5/e: https://www.cs.vu.nl/~ast/CN5/https://nptel.ac.in/courses/106105081
- 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
22CDS52.1	3		1											1
22CDS52.2	3													
22CDS52.3		1	2											
22CDS52.4	2		1											
22CDS52.5		1	3											
22CDS52.6					3				1		1		1	2

1: Low 2: Medium 3: High

Fundamentals of AI and ML			
Course Code	**22CDS53**	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 Objective: 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: Intelligent Agents **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, Informed search strategies, Heuristic functions, Uninformed search strategies. **TB1: 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 task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm. **TB2: Ch-1, 2**

Module-4: Decision Trees & Reinforcement Learning **8 hours**

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. Reinforcement Learning: Introduction, The learning task, Q-Learning. **TB2: 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. **TB2: 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:	
22CDS53.1	Demonstrate a thorough understanding of the foundational concepts of Artificial Intelligence.
22CDS53.2	Develop proficiency in problem-solving techniques.
22CDS53.3	Acquire comprehensive knowledge of Machine Learning (ML) concepts, enabling them to analyze and implement ML algorithms effectively.
22CDS53.4	Gain the basics of Decision Tree and Reinforcement Learning (RL)
22CDS53.5	Identify the Bayesian Rule and its applications.
22CDS53.6	Compare 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 Tutorialss & Notes | Machine Learning | HackerEarth
- History of Artificial Intelligence - Javatpoint
- Heuristic Search Techniques in Artificial Intelligence - TechVidvan
- http://14.139.161.31/OddSem-0822-1122/Hands-On_Machine_Learning_with_Scikit-Learn Keras-and-TensorFlow-2nd-Edition-Aurelien-Geron.pdf
- 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**
22CDS53.1	1	2	2										1	
22CDS53.2		2											1	2
22CDS53.3		2			1								2	1
22CDS53.4		2			2								2	1
22CDS53.5	2	2	2		2								2	
22CDS53.6	2	2			1								2	

1: Low 2: Medium 3: High

Principles of Data Science			
Course Code	**22CDS54**	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

- Apply the basic concepts of data science.
- Enable students to handle various dataset.
- Train the applications of data science and perform data transformation.
- Design and map elements of visualization well to perceive information

Module-1: Introduction to Data Science **(8 hours)**

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? Datafication, Current landscape of perspectives, Skill sets Needed.
Statistical Inference: Populations and samples, Statistical modeling, probability distributions, fitting a model.
TB 1: Ch-1

Module-2: Exploratory Data Analysis and the Data Science **(8 hours)**

Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,
Data Science Process:Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Case Study: Real Direct(online real estate firm).
TB 1: Ch-2, 3

Module-3: Feature Generation and Feature Selection **(8 hours)**

Extracting Meaning from Data: Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests.
Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis.
TB 1: Ch-6

Module-4: Data Visualization and Data Exploration **(8 hours)**

Introduction: Data Visualization, Importance of Data Visualization, Data Wrangling, Tools and Libraries for Visualization Comparison Plots: Line Chart, Bar Chart and Radar Chart; Relation Plots: Scatter Plot, Bubble Plot, Correlogram and Heatmap
Composition Plots: Pie Chart, Stacked Bar Chart, Stacked Area Chart, Venn Diagram; Distribution Plots: Histogram, Density Plot, Box Plot, Violin Plot; Geo Plots: Dot Map, Choropleth Map Connection Map.**Exercise:** What Makes a Good Visualization?
TB 2: Ch-1, 2

Module-5: Deep Dive into Matplotlib **(8 hours)**

Introduction: Overview of Plots in Matplotlib, **Pyplot Basics**: Creating Figures, Closing Figures, Format Strings, Plotting, Plotting Using pandas DataFrames, Displaying Figures, Saving Figures;
Basic Text and Legend Functions: Labels, Titles, Text, Annotations, Legends;
Basic Plots and examples: Bar Chart, Pie Chart, Stacked Bar Chart, Stacked Area Chart, Histogram, Box Plot, Scatter Plot, Bubble Plot; Layouts: Subplots, Tight Layout, Radar Charts, GridSpec
Images: Basic Image Operations, Writing Mathematical Expressions
TB 2: Ch-3

Course Outcomes: At the end of the course the student will be able to:	
22CDS54.1	Explain the data in different forms.
22CDS54.2	Apply different techniques to Explore Data Analysis and the Data Science Process
22CDS54.3	Distinguish feature selection algorithms.
22CDS54.4	Apply data visualization tools and libraries to plot graphs.
22CDS54.5	Examine different charts and include mathematical expressions.
22CDS54.6	Integrate learned concepts of data science and current technology.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Doing Data Science, Straight Talk from The Frontline	Cathy O'Neil and Rachel Schutt	O'Reilly	1st Edition, 2013
2	Data Visualization Workshop	Tim Grobmann and Mario Dobler	Packt Publishing	1st Edition, 2020
Reference Books				
1	Data Science from Scratch	Joel Grus	O'Reilly Publisher Media	2nd Edition, 2013
2	Mining of Massive Datasets	Anand Rajaraman and Jeffrey D. Ullman	Cambridge University Press	2nd Edition, 2010

Web links and Video Lectures (e-Resources):

- NPTEL/ https://nptel.ac.in/courses/106105077
- Visualising Data : A Handbook for Data Driven Design / http://book.visualisingdata.com/
- https://matplotlib.org/
- https://docs.python.org/3/tutorial/
- Doing Data Science (oreilly.com)/ https://www.oreilly.com/library/view/doing-data-science/9781449363871/toc01.html

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS54.1	2	2			2				2					3
22CDS54.2					2	3								3
22CDS54.3					2							1		
22CDS54.4					2	2								1
22CDS54.5					2				2					
22CDS54.6	2	2			2							3		3

1: Low 2: Medium 3: High

Data Visualization Laboratory			
Course Code	**22CDS55L**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	01	Exam Hours	03

Course Learning Objectives:

- Understand Fundamental Data Science Concepts
- Develop Proficiency in Data Visualization
- Apply Machine Learning Algorithms
- Develop Skills in Exploratory Data Analysis (EDA)
- Execute Real-world Data Projects

Laboratory Programs:	**PART- A**
1.	Create a lab program for students to analyse the **Iris dataset** using the Pandas library in Python, where they will perform tasks such as data cleaning, data manipulation, and basic statistical analysis to gain insights into the dataset.
2.	Design a lab program using **Titanic Dataset** where students learn to create various types of plots using the Matplotlib library in Python, enabling them to visualize datasets and effectively understand patterns and trends.
3.	Develop a lab program with **Gapminder Dataset**, that focuses on interactive data visualization using the Plotly library in Python, allowing students to create and customize interactive plots such as scatter plots, bar charts, and heatmaps with features like hover tooltips and zoom functionalities.
4.	Create a lab program that introduces students to machine learning concepts using the Scikit-Learn library in Python, where they will implement basic supervised learning algorithms like linear regression and logistic regression on the **Iris datasets.**
5.	Design a lab program using **California Housing Prices Dataset,** where students practice classification and regression analysis techniques using Scikit-Learn, allowing them to work on real-world datasets, build predictive models, and evaluate model performance using metrics like accuracy, precision, recall, and RMSE.
6.	Develop a lab program using **MNIST Handwritten Digits Dataset,** that focuses on Dimensionality reduction techniques, specifically Principal Component Analysis (PCA), allowing students to visualize high-dimensional data in lower dimensions and better understand the data structure.
7.	Develop a machine learning model that can identify hate tweets by preprocessing text data, extracting features, training a classifier by using the **Hate Speech and Offensive Language Dataset** and evaluating its performance.
8.	Create a lab program using **any Sales/Supermarket Dataset** where students learn time series analysis techniques using libraries like Pandas and Statsmodels in Python, enabling them to explore time series data, perform decomposition, forecasting, and anomaly detection tasks.
9.	Develop a lab program using **Iris Dataset** and focusing on clustering algorithms, specifically K-means clustering and hierarchical clustering, using Scikit-Learn. Students will apply these algorithms to segment data into distinct clusters based on similarity patterns.
10.	Create a lab program using the **NYC Taxi Trip Duration dataset**, where students learn big data analytics using Apache Spark, focusing on processing large-scale datasets, implementing machine learning algorithms with Spark MLlib, and visualizing results using Spark's built-in tools.
	PART-B
	With the knowledge attained above, develop a python application on any suitable data set and demonstrate data science techniques.

Course Outcomes: At the end of the course the student will be able to:	
22CDS55L.1	Apply Data Manipulation Techniques and preprocess datasets using appropriate techniques, including cleaning, transforming, and merging data, to prepare them for analysis.
22CDS55L.2	Illustrate Statistical Analysis and demonstrate the ability to perform statistical analysis on datasets and derive meaningful insights and make data-driven decisions.
22CDS55L.3	Apply machine learning algorithms, including classification, regression, and clustering techniques, to analyze data, make predictions, and uncover patterns and relationships.
22CDS55L.4	Compare Exploratory Data Analysis (EDA) to analyse the structure and characteristics of datasets, identify trends, outliers, and anomalies, and generate hypotheses for further analysis.
22CDS55L.5	Evaluate Model Performance of machine learning models using appropriate metrics and techniques, such as cross-validation, to assess predictive accuracy and generalization to new data.
22CDS55L.6	Analyze emerging technologies and tools in the field of data science and visualization, staying current with industry trends and developments to solve real-world problems effectively.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1.	Python for Data Analysis	Wes McKinney	O'Reilly Media	2nd Edition, 2017
Reference Books				
1.	Python Data Science Handbook: Essential Tools for Working with Data	Jake VanderPlas	O'Reilly Media	1st Edition, 2016

Web links/Video Lectures/MOOCs/papers

- https://youtu.be/9YTNYT1maa4?si=wyTwEVgFef53ue_t
- https://youtu.be/l7cAdp0f4X03

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS55L.1	3				2			2					2	3
22CDS55L.2		2	2		2									
22CDS55L.3		2			2				2				2	
22CDS55L.4			1		2				2			2		
22CDS55L.5			1		2						1		2	
22CDS55L.6					2					3		1		3

1: Low 2: Medium 3: High

Data Compression Techniques			
Course Code	**22CDS561**	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 various compression techniques, including modeling and coding.
- Master essential mathematical concepts for lossless compression.
- Implement Huffman and Arithmetic coding algorithms efficiently.
- Explore dictionary-based, context-based, and image compression methods, along with scalar and vector quantization techniques.

Module-1 : Introduction and Mathematics for Lossless Compression **8 hours**

Compression Techniques, Modeling and Coding. Overview, A brief introduction to Information Theory, Models, Coding, Algorithmic Information Theory, Minimum Description Length Principle.
TB1: Ch- 1, 2

Module-2 : Huffman and Arithmetic Coding **8 hours**

Overview, The Huffman Coding Algorithm, Nonbinary Huffman Codes, Adaptive Huffman Coding, Golomb Codes, Rice Codes, Tunstall Codes, Applications of Huffman Coding. Overview, Introduction, Coding a Sequence, Generating a Binary Code, Adaptive Arithmetic Coding, Binary Arithmetic Coding, Comparison of Huffman and Arithmetic Coding, Applications.
TB1: Ch- 3, 4

Module-3 : Dictionary Techniques and Context-Based Compression **8 hours**

Overview, Introduction, Static Dictionary, Adaptive Dictionary, Grammar-Based Compression, Applications, Beyond Compression.
Overview, Introduction, Prediction With Partial Match, The Burrows-Wheeler Transform, Associative Coder of Buyanovsky, Dynamic Markov Compression.
TB1: Ch- 5, 6

Module-4 : Lossless Image Compression and Preliminaries for Lossy Coding **8 hours**

Overview, Introduction, CALIC, JPEG-LS, Prediction Using Conditional Averages, Multiresolution Approaches, Lossless Image Compression Formats, Facsimile Encoding, MRC-T.44.
Overview, Introduction, Distortion Criteria, Information Theory Revisited, Rate Distortion Theory, Models.
TB1: Ch- 7, 8

Module-5 : Scalar and Vector Quantization **8 hours**

Overview, Introduction, The Quantization Problem, Uniform Quantizer, Adaptive Quantization, Nonuniform Quantization, Entropy-Coded Quantization.
Overview, Introduction, Advantages of Vector Quantization Over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree-Structured Vector Quantizers, Structured Vector Quantizers, Variations on the Theme, Trellis-Coded Quantization.
TB1: Ch- 9, 10

Course Outcomes: At the end of the course the student will be able to:	
22CDS561.1	Define fundamental concepts in lossless compression and information theory.
22CDS561.2	Explain the Huffman coding algorithm and arithmetic coding methods.

22CDS561.3	Apply dictionary and context-based compression techniques to data.
22CDS561.4	Analyze lossless image compression methods and lossy coding principles.
22CDS561.5	Compare scalar and vector quantization techniques in compression.
22CDS561.6	Design and implement a comprehensive compression project integrating techniques

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1.	Introduction to Data Compression	Khalid Sayood	Morgan Kaufmann	January 1, 2013
Reference Books				
1.	Data Compression: The Complete Reference	David Salomon	Springer	4th Edition, 2007
2.	Information Theory, Inference, and Learning Algorithms	David MacKay	Cambridge University Press	1st Edition, 2003
3.	The Data Compression Book	Mark Nelson, Jean-Loup Gailly	M & T Books	2nd Edition,1995
4.	Image and Video Compression: Fundamentals, Techniques, and Applications	Madhu S. Nair, K.R. Rao	CRC Press	1st Edition, 2013

Web links and Video Lectures (e-Resources):

- https://www2.seas.gwu.edu/~ayoussef/cs6351/
- https://stanforddatacompressionclass.github.io/Fall22/
- https://www.youtube.com/playlist?list=PLv_7iO_xlL0Jgc35Pqn7XP5VTQ5krLMOl
- https://github.com/jermp/data_compression_course

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS561.1		2	1		1	1								
22CDS561.2	2		1			1		1						
22CDS561.3				2	2			2						
22CDS561.4			2			2					2			2
22CDS561.5			2		2				2	2				2
22CDS561.6	2	2		1	1									

1: Low 2: Medium 3: High

Human Computer Interaction			
Course Code	**22CDS562**	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

1. Demonstrate knowledge of human computer interaction design concepts and related methodologies.
2. Recognize theories and concepts associated with effective user interface design to real-world applications.
3. Improve quality and design.
4. Apply models from cognitive psychology to predicting user performance in various human-computer interaction tasks
5. Conceptualize, design and evaluate interactive products systematically.

Module-1: User Interface Introduction **(8 hours)**

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, characteristics, Web user – Interface popularity, characteristics Principles of user interface.

TB1: Ch-1, 2

Module-2: Design Process **(8 hours)**

Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully–Technological consideration in interface design.

TB1:Part2, TB2:Ch-5

Module-3: Windows **(8 hours)**

New and Navigation schemes selection of window- structure-functions-content-formatting-phrasing-navigating-kinds of graphical menus. Select the proper kinds of windows-component of window,types of windows,window management and operations. Characteristics of device based controls.

TB1: Part2-Step5

Module-4: HCI **(8 hours)**

The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multimodal interaction

TB2: Ch-6, 7, 9, 10

Module 5: Cognitive models **(8 hours)**

Cognitive models Goal and task hierarchies Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience Design Focus: Applications of augmented reality Information and data visualization Design Focus: Getting the size right.

TB2: Ch:12, 20

Course Outcomes: At the end of the course the student will be able to:	
22CDS562.1	Demonstrate Understanding of Interaction between the human and computer components
22CDS562.2	Apply principles to evaluate and critique interaction design.
22CDS562.3	Apply principles of screen planning and screen design to create effective user interfaces
22CDS562.4	Design cohesive user interfaces for Windows applications, ensuring consistency in layout, navigation, and visual elements.
22CDS562.5	Apply cognitive, linguistic, physical and device models, and cognitive architectures to design effective user interfaces and interactive systems
22CDS562.6	Analyze cognitive models, linguistic models, physical and device models ensuring effective design

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	The essential guide to user interface design	Wilbert O Galitz	Wiley Dream Tech.	3rd Edition ,2014
2	Human Computer Interaction	Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg	Pearson Publications	3rd Edition, 2004
Reference Books				
1	Designing the user interface	Ben Shneidermann	Pearson	3rd Edition, 2018
2	Interaction Design	Prece, Rogers, Sharps,	Pearson Education	3rd Edition, 2013
3	User Interface Design	Soren Lauesen	Soren Lauesen	10th Edition, 2022
4	Human Computer Interaction	D. R. Olsen	Cengage Learning.	1st Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=aLUW_M-f2No
- https://www.youtube.com/watch?v=uB9LaBIAcRs&list=PLQ-nEJNYlEV1CfTcLCx_S7D2of3QAsvTT

1. https://www.youtube.com/watch?v=yKbhoxbkUM0&list=PLYwpaL_SFmcDz_8-pygbcNvNF0DEwKoIL&index=18

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS562.1	2					2							2	
22CDS562.2	2		2		2				2					2
22CDS562.3			2		2				2	2				
22CDS562.4														
22CDS562.5	2				2				2	2			2	
22CDS562.6					2				3	2			2	

1: Low 2: Medium 3: High

Natural Language Processing			
Course Code	**22CDS563**	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 Theory	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.
- Explain the applications of NLP and challenges in processing natural language texts.

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- N-gram models.
TB1: Ch-1, TB2: 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
TB2: Ch-3

Module-3: Syntactic 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 19, 20.1, 21 TB2: Ch 5

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-20, 22 TB2: Ch-5, 6

Module-5: Introduction to Speech Processing **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:	
22CDS563.1	Discuss importance of NLP and the techniques used for language modeling in NLP
22CDS563.2	Discover the tools and techniques for Processing natural language texts at word and sentence level.
22CDS563.3	Analyze natural language texts for syntax.
22CDS563.4	Analyze natural language texts for semantics and pragmatics.
22CDS563.5	Examine real world applications involving natural language processing techniques.
22CDS563.6	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	Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems	Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana	O'Reilly Media, Inc.	1st Edition, 2020
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
22CDS563.1			2											
22CDS563.2				2	2									
22CDS563.3		2	2											
22CDS563.4		2	2											
22CDS563.5		2	2											
22CDS563.6					2								1	

1: Low 2: Medium 3: High

Business Intelligence			
Course Code	**22CDS564**	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 Business Intelligence, Analytics and Decision Support system.
- Understand decision making process and identify the technologies for decision support systems.
- Understand data warehousing, business reporting, visual analytics and business performance management operations.
- Understand the importance of data mining for the decision-making process.
- Understand importance of modelling and automated decision systems in various applications

Module-1:Introduction to Business Intelligence, Analytics and Decision Support (8 hours)

Overview of Business Intelligence, Analytics and Decision Support: Changing Business Environments and Computerized Decision Support, Managerial decision making, Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems(DSS), A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics. Case Study: Business Intelligence, Business Analytics and Big Data. **TB1.**

Module-2: Decision Making and Decision Support Systems (8 hours)

Foundations and Technologies for Decision Making: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components. Case Study: Decision making and Decision Support components. **TB1**

Module-3: Descriptive Analytics: Data warehousing and Business Reporting (8 hours)

Data warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes. Data warehouse Development, Data Warehousing Implementation Issues.

Business Reporting, Visual Analytics, Business Performance Management: Business Reporting Definitions and Concepts, Data and Information Visualization, Different Types of Charts and Graphs, The Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Business Performance Management, Performance Measurement, Balanced Scorecards, Six Sigma as a Performance Measurement System Case Study: Data Warehousing, ETL, Business Reporting. **TB1.**

Module-4: Predictive Analytics: Data Mining (8 hours)

Data Mining: Data Mining Concepts and Applications, Data Mining Applications, Data Mining Process, Data Mining Methods, Data Mining Software Tools, Data Mining Privacy Issues, Myths, and Blunders. Case Study: Data mining and Prediction applications. **TB1.**

Module-5: Model based Decision Making and Expert Systems (8 hours)

Model based Decision Making: Decision Support Systems Modeling, Structure off Mathematical

Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems.Case Study: Application of expert systems. **TB1.**

Course Outcomes: At the end of the course the student will be able to:	
22CDS564.1	Apply the types of data to the Decision Support systems and Business Intelligence framework.
22CDS564.2	Apply the decision making process and DSS concepts in the business applications supporting problem resolution..
22CDS564.3	Analyze the importance of data warehousing and business reporting tools to perform descriptive analytics for business issues in the organizations.
22CDS564.4	Analyze the relevance of data mining based predictions in decision making to perform prescriptive analytics for business decisions in the organizations.
22CDS564.5	Analyze the value of model based and expert systems in the decision making process and also discuss areas suitable for application of expert system.
22CDS564.6	Analyze the influence of technologies & business intelligence in overcoming the issues in various business application cases.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Business Intelligence and Analytics: Systems for decision support	Ramesh Sharda, Dursun Delden, Efraim Turban	Pearson Publishers	10th Edition, 2015
Reference Books				
1	Business Intelligence The Savvy Manager's Guide	David Loshin	Elsevier Publishers	2nd Edition, 2013
2	Fundamentals of Business Analytics	R N Prasad, Seema Acharya	Wiley Publishers	2nd Edition, 2016
3	Data Mining Techniques. For Marketing, Sales and Customer Relationship Management	Berry M. & Linoff G	Wiley Publishing Inc	2nd Edition, 2004
4	Data Science for Business	Foster Provost and Tom Fawcett	O'Reilly Media,Inc	1st Edition, 2013

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dn97ux9exbY
- https://www.youtube.com/watch?v=N8F7eOqgH8Q
- https://www.youtube.com/watch?v=zbcCdoHeS4w
- https://www.youtube.com/watch?v=KSJqdMqLQA4
- https://www.youtube.com/watch?v=jkCCnwvO_fg
- https://www.youtube.com/watch?v=Yb2KF-sAJh4
- https://www.netsuite.com/portal/resource/articles/business-strategy/business-intelligence-examples.shtml

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS564.1	1								1	2			1	
22CDS564.2	2								1	2			1	
22CDS564.3	2		2		2				1	2			1	
22CDS564.4	2		2						1	2			2	
22CDS564.5	2		2						1	2			2	1
22CDS564.6	2				2				1	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

Digital Image Processing			
Course Code	**22CDS61**	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

- Understand the fundamentals of digital image processing.
- Know image transformation techniques used in digital image processing.
- Understand the image enhancement techniques used in digital image processing.
- Learn the image restoration techniques, Morphological Operations and Segmentation used in digital image processing.
- Apply the digital image processing techniques in real-time captured images.

Module-1: Digital Image Fundamentals **(8 hours)**

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

TB1: Ch 1, Ch 2 - 2.1 to 2.5, 2.6.2

Module-2: Spatial and Frequency Domain **(8 hours)**

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering,-Smoothing Spatial Filters, Sharpening Spatial Filters.

Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, and Selective Filtering.

TB1: Ch 3 - 3.2 to 3.6 , Ch 4 - 4.2, 4.5 to 4.10

Module-3: Image Restoration **(8 hours)**

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, and Constrained Least Squares Filtering.

TB1: Ch 5 - 5.2 to 5.9

Module-4: Processing Images **(8 hours)**

Color Image Processing: Color Fundamentals, Color Models, and Pseudo-color Image Processing **Wavelets:** Background, Multiresolution Expansions. **Morphological Image Processing** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, and Som Basic Morphological Algorithms.

TB1: Ch 6 - 6.1 to 6.3, Ch 7 – 7.1,7.2, Ch 9 - 9.1 to 9.5

Module-5: Image Segmentation **(8 hours)**

Segmentation: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, and Principles of Thresholding. **Representation & Description:** Representation, Boundary descriptors.

TB2: Ch 9 - 9.1 to 9.7 TB 1: Ch 11 - 11.1 , 11.2

PRACTICAL MODULE

1. Write a Program to read a color digital image and perform the following:
   (i) Split and display its RGB channels. Apply zeros to other channels, display RGB channels again, and observe the differences.
   (ii) Convert it to grayscale and binary image. Display all the images one by one along with its histogram.
2. Write a Program to read a digital image and perform the following:
   (i) Split and display image into four quadrants – Topleft, Top Right, Bottom Left and Bottom Right.
   (ii) Demonstrate rotation, scaling, and translation of an image.
3. Demonstrate different image transformation like Negative, Logarithmic and Power-Law (gamma) techniques.
4. Demonstrate histogram equalization, contrast stretching and bit-plane slicing for a low contrast 2D image.
5. Demonstrate Smoothing, Sharpening and Noise removal for a poor quality image.
6. Write a Program to read an image, first apply erosion to the image and then subtract the result from the original. Apply dilation to the image and then subtract it with the original. Observe and demonstrate the differences in each.
7. Write a Program to read an image. Extract and display low-level features, textures features and color features.
8. Demonstrate Edge detection and Region-Based segmentation in an image.

OPEN ENDED EXPERIMENTS

1. Classification of Image Category
2. Detection of Skin Disease or Plant Disease

Course Outcomes: At the end of the course the student will be able to:	
22CDS61 .1	Describe the basics of image processing concepts through mathematical interpretation.
22CDS61 .2	Apply image processing techniques in both the spatial and frequency (Fourier) domains.
22CDS61 .3	Experiment with image restoration process and its respective filters
22CDS61 .4	Analyze different image enhancement techniques in the form of image segmentation.
22CDS61 .5	Evaluate the Methodologies for Edge and Shape Detection.
22CDS61 .6	Develop independent study for Image Enhancement techniques.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Image Processing	Rafael C. Gonzalez, Richard E. Woods	Prentice Hall	4th Edition, 2018
2	Digital Image Processing	S. Sridhar	Oxford University Press	2nd Edition, 2016
Reference Books				
1	Fundamentals of Digital Image Processing	A. K. Jain	Pearson	1st Edition, 2015

2	Digital Image Processing Using MATLAB	Ralph Gonzalez, Richard Woods, Steven Eddins	McGraw Hill Education	2nd Edition, 2017

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc19_ee55/preview
- https://www.mygreatlearning.com/academy/learn-for-free/courses/digital-image-processing
- https://www.coursera.org/learn/digital
- https://free.aicte-india.org/Digital-Image-Processing.php
- https://www.youtube.com/watch?v=1I6kfkY4GyQ
- https://www.youtube.com/watch?v=CVV0TvNK6pk

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS61 .1			2		1					1				
22CDS61 .2				2	1					2		2		
22CDS61 .3					2		2						2	
22CDS61 .4				2	2							2		
22CDS61 .5					2		1					1	2	
22CDS61 .6			2		2									

1: Low 2: Medium 3: High

Automata Theory and Compiler Design			
Course Code	**22CDS62**	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:	
22CDS62.1	Apply the core concepts of automata theory for Finite State Machines.
22CDS62.2	Solve formal language problems by writing appropriate grammars and Turing Machines.
22CDS62.3	Apply basic steps of compilation process to show the different phases of translation for a given source language statement.
22CDS62.4	Construct Parsing Tables using appropriate parsing algorithms.
22CDS62.5	Analyze the back end of compilation process in generating target code.
22CDS62.6	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	Theoryof 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
22CDS62.1	2	2												1
22CDS62.2			2	2										2
22CDS62.3	2		2											
22CDS62.4		2	1											
22CDS62.5		2		1	2									
22CDS62.6				3	2									2

1: Low 2: Medium 3: High

Data Security and Privacy			
Course Code	**22CDS63**	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

1. Apply and analyze monoalphabetic and polyalphabetic substitution ciphers.
2. Implement and evaluate stream and block cipher techniques.
3. Explore data hiding techniques in text and images.
4. Investigate big data's impact on security and social engineering.

Module-1:Data Encryption **(8 hours)**

Monoalphabetic Substitution Ciphers: Letter Distributions, Breaking a Monoalphabetic Cipher, The Pigpen Cipher, Polybius's Monoalphabetic Cipher, Extended Monoalphabetic Ciphers, The Playfair Cipher , Homophonic Substitution Ciphers.
Transposition Ciphers: Simple Examples, Cyclic Notation and Keys, Transposition by Turning Template, Columnar Transposition Cipher, Double Transposition, A 2-Step ADFGVX Cipher, An Approach to Decryption. **TB1: Ch1, 2**

Module-2: Polyalphabetic Substitution Ciphers **(8 hours)**

Self-Reciprocal Ciphers, The Porta Polyalphabetic Cipher, The Beaufort Cipher, Trithemius Cipher, The Vigenere Cipher, Breaking the Vigenere Cipher, Long Keys, Variation on Vigenere, The Gronsfeld Cipher, The Eyraud Cipher, The Hill Cipher, The Jefferson Multiplex Cipher, Strip Ciphers, Polyphonic Ciphers and Ambiguity, The Index of Coincidence, Polybius's Polyalphabetic Cipher. **TB1: Ch-3**

Module-3: Stream and Block Ciphers **(8 hours)**

Symmetric Key and Public Key, Stream Ciphers, Linear Shift Registers , Cellular Automata, Nonlinear Shift Registers, Other Stream Ciphers, Dynamic Substitution, The Latin Square Combiner, SEAL Stream Cipher,RC4 Stream Cipher.
Block Ciphers: Block Ciphers, Lucifer, The Data Encryption Standard, Blowfish, IDEA, RC5, Rijndael. **TB1: Ch-6, 7**

Module-4: Data Hiding in Images and Text **(8 hours)**

Data Hiding in Text: Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods, Simple Digital Methods, Data Hiding in Text, Innocuous Text,Mimic Functions.
Data Hiding in Images: LSB Encoding, BPCS Steganography, Lossless Data Hiding, Spread Spectrum Steganography, Data Hiding by Quantization, Patchwork, Signature Casting in Images, Transform Domain Methods, Robust Data Hiding in JPEG Images, Robust Frequency Domain Watermarking, Detecting Malicious Tampering, Wavelet Method, The Zhao-Koch Method, The Wu-Lee Method, The CPT Method, The TP Method. **TB1: Ch-10, 11.**

Module-5: Big Data and Data Secuity **(8 hours)**

Use of Big Data in Hacking and Social Engineering: Introduction to big data- Application of big data, The result, Hacking- Big data versus ethical hacking, Social Engineering- Lifecycle of well-organized attack, Types of social engineering, Big Data versus social engineering.
Big Data security issues with challenges and solutions: Introduction, Cloud Computing, Big data- Hadoop distribution file system, MapReduce. **TB2: Ch-4, 6**

Course Outcomes: At the end of the course the student will be able to:	
22CDS63.1	Explain basic cryptography concepts and historical ciphers.
22CDS63.2	Analyze substitution and transposition ciphers.

22CDS63.3	Describe poly alphabetic substitution ciphers.
22CDS63.4	Identify the role of random number generation in cryptography.
22CDS63.5	Recognize advanced cryptography techniques.
22CDS63.6	Evaluate public-key cryptography, quantum cryptography and data hiding methods.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1.	Data Privacy and Security	David Salomon	Springer-Verlag New York Inc	1st Edition, 2011
2.	Big Data Security	Shibakali Gupta, Indradip Banerjee, Siddhartha Bhattacharyya	De Gruyter	1st Edition, 2019
Reference Books				
1.	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson	7th Edition, 2021
2.	Security Engineering: A Guide to Building Dependable Distributed Systems	Ross J. Anderson	Wiley	2nd Edition, 2008
3.	Network Security Essentials: Applications and Standards	William Stallings	Pearson	7th Edition, 2017
4.	Practical Cryptography for Developers: Key Concepts, Techniques, and Tools	Svetlin Nakov, Bartosz Karpinski, and others	Apress	1st Edition, 2019

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=kf5JbXdwiyE
- https://www.youtube.com/watch?v=Ic4BzVggNY8
- https://www.youtube.com/watch?v=Xozxq3hxwRM
- https://www.youtube.com/watch?v=GvbbvrVPcgA
- https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS63.1	2	2	1										1	
22CDS63.2		3	2											
22CDS63.3			2	2		1							2	
22CDS63.4				2										
22CDS63.5			2		2	3								
22CDS63.6			2	2										

1: Low 2: Medium 3: High

Full Stack Development			
Course Code	**22CDS641**	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 Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Illustrate the Semantic Structure of HTML and CSS
- Design Client-Side programs using JavaScript
- Understand the basics of React and create components and lifecycle
- Build applications using React JSX and Node.js
- Design databases using MongoDB

Module-1: HTML and CSS **(8 hours)**

Introduction to HTML: What is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements. **Introduction to CSS:** What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: HowStyles Interact, The Box Model, CSS Text Styling. **TB1: Ch- 2, 3**

Module-2: JavaScript and React Basics **(8 hours)**

JavaScript: Client-Side Scripting: What is JavaScript and What can it do? JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms.
Hello World: Hello React World, What Just Happened? React.createElement(), JSX, Setup Babel.**The Life of a Component:** A Custom Function Component, A Custom Class Component,Properties, State, A textarea Component, Make It Stateful.
TB1: Ch- 6 and TB2: Ch-1, 2

Module-3: Advanced React **(8 hours)**

The Life of a Component: A Note on DOM Events, Props Versus State, Props in Initial State, Accessing the Component from the Outside, Lifecycle Methods, Lifecycle Example: Log It All, Lifecycle Example: Using a Child Component.
JSX: A Couple Tools, Whitespace in JSX, Comments in JSX, HTML Entities, Spread Attributes, Returning Multiple Nodes in JSX. **TB2: Ch-2, 5**

Module-4: Node.js **(8 hours)**

Welcome to Node.js: Built on JavaScript, Asynchronous and evented, DIRTy applications, DIRTyby default.
Building a Multiroom Chat Application: Application overview, Application requirements and initial setup, Serving the application's HTML, CSS, and client-side JavaScript, Handling chat-related messaging using Socket.IO, Using client-side JavaScript for the application's user interface.
TB3: Ch-1, 2

Module-5:MongoDB and Databases **(8 hours)**

Getting Started: Documents, Collections, Databases, Starting MongoDB, Introduction to the MongoDB Shell, Data Types, Using the MongoDB Shell.
Creating, Updating, and Deleting Documents: Inserting Documents, Removing Documents, Updating Documents. **Querying**: Introduction to find, Query Criteria, Type-Specific Queries, $where Queries, Cursors. **TB1: Ch-2, 3, 4**

Course Outcomes: At the end of the course the student will be able to:	
22CDS641.1	Apply HTML and CSS syntax and semantics to build web pages
22CDS641.2	Design Client-Side Scripts using JavaScript
22CDS641.3	Apply the concepts of React to create Components and design applications using the Life cycle method

22CDS641.4	Build applications using React JSX
22CDS641.5	Develop applications using Node.js
22CDS641.6	Construct Databases using MongoDB

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Fundamentals of Web Development	Randy Connolly, Ricardo Hoar	Pearson Education India	1st Edition, 2015
2	React: Up & Running: Building Web Applications	Stoyan Stefanov	O'Reilly Media,Inc.	2nd Edition, 2021
3	Node.js in Action	Mike Cantelon, MarcHarter, T.J. Holowaychuk, and Nathan Rajlich	Manning Publications	1st Edition, 2014
Reference Books				
1	Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML5	Robin Nixon	O'Reilly Publications	4th Edition, 2015
2	Professional JavaScript for Web Developers	Nicholas C Zakas	Wrox/Wiley India	3rd Edition, 2012
3	Node.js Web Development	David Herron	Packt Publishing	4th Edition, 2018
4	Fullstack React: The Complete Guide to ReactJS and Friends	Anthony Accomazzo, AriLerner, Nate Murray, Clay Allsopp, David Gutman, Tyler McGinnis	Fullstack.io	1st Edition, 20

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=kf5JbXdwiyE**
- **https://www.youtube.com/watch?v=Ic4BzVggNY8**
- **https://www.youtube.com/watch?v=Xozxq3hxwRM**
- **https://www.youtube.com/watch?v=GvbbvrVPcgA**
- https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop

Course Outcomes COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS641.1	3				2								2	
22CDS641.2		2			2								2	
22CDS641.3	3												2	
22CDS641.4		2			2								2	
22CDS641.5	3				2									1
22CDS641.6	2				2									1

1: Low 2: Medium 3: High

Blockchain Technology			
Course Code	**22CDS642**	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.
- Understand Hyperledger fabric and its framework.

Module-1 : Blockchain 101 and Decentralization **8 hours**

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

Module-2 : Bitcoin and Alternative Coin **8 hours**

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

Module-3 : Smart Contracts and Ethereum 101 **8 hours**

Definition, Ricardian contracts.
Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts
TB1: Ch- 9,10

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

Languages, Compilers, Solidity compiler (solc) Installation on Linux, Installation on macOS, Integrated Development Environments (IDEs), Tools and libraries, Ganache MetaMask, Truffle Installation, Contract development and deployment.
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 and Blockchain-Outside of Currencies **8 hours**

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,
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:	
22CDS642.1	Explain the fundamental building blocks of Blockchain technology.
22CDS642.2	Discuss the concepts of Bitcoin and their usage in various blockchain applications.
22CDS642.3	Use the concept of smart contracts and Ethereum and their application in various applications
22CDS642.4	Execute smart contract using Solidity, Remix IDE and Ethereum frameworks.
22CDS642.5	Analyze Hyperledger fabric including its framework, design principles and architecture
22CDS642.6	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	First Edition, 2020
2.	Bitcoin and Cryptocurrency Technologies	Arvind Narayanan, Joseph Bonneau, Edward	Princeton University Press	1st Edition, 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

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Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105184/
- blockgeeks.comguide/what-is-block-chain-technology
- 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=AWPisuBx1Zo
- 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
22CDS642.1	2	1				1							1	
22CDS642.2	1	2	1		1			1						
22CDS642.3	1			2									2	
22CDS642.4		1	2	1	2			1						
22CDS642.5	2	1		1	2	1							2	
22CDS642.6			1	1	2			2					1	

1: Low 2: Medium 3: High

Deep Learning and Neural Networks			
Course Code	**22CDS643**	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 major deep neural network frameworks and issues in basic neural networks.
- To solve real-world applications using Deep learning.
- Identify and apply suitable deep learning approaches for given application.

Module-1 : Introduction to Neural Networks and Deep Neural Networks **8 hours**

Introduction: The Neuron, Expressing Linear Perceptron as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, SoftMax Output Layer, Deep Neural Networks – Forward and Back Propagation – Parameters – Hyper parameters.

TB1

Module-2 : Training feed-forward Neural Network **8 hours**

Gradient Descent, Gradient Descent with Sigmoidal Neurons, Stochastic and Minibatch Gradient Descent, Test Sets, Validation Sets, and Overfitting, Preventing Overfitting in Deep Neural Networks, RMSProp and Adam Optimization, Implementation of neural network using TensorFlow.

TB1

Module-3 : Convolutional Neural Network **8 hours**

Foundations of Convolutional Neural Networks – CNN operations – Architecture– Simple Convolution Network – Deep Convolutional Models – ResNet, AlexNet, Inception Net and others.

TB1, TB2

Module-4 : Models for Sequence Analysis **8 hours**

Recurrent Neural Networks, The Challenges with Vanishing Gradients, Long Short-Term Memory (LSTM) Units, TensorFlow Primitives for RNN Models , Implementing a Sentiment Analysis Model, Solving seq2seq Tasks with Recurrent Neural Networks

TB1

Module-5 : Introduction to Auto Encoders and GAN **8 hours**

Autoencoders: Efficient data representation, Performing PCA, Stacked, Autoencoders, Denoising, Sparse autoencoders, variational and other autoencoders. Generative Adversarial Networks.

TB1, TB2

Course Outcomes: At the end of the course, the student will be able to:	
22CDS643.1	Describe the basic concepts of Neural Networks and Deep Learning.
22CDS643.2	Implement neural networks in TensorFlow with varied gradient descent, optimization methods.
22CDS643.3	Analyze CNN fundamentals, operations, architectures: ResNet, AlexNet, Inception Net.
22CDS643.4	Develop Deep Learning models for sequence analysis.
22CDS643.5	Explain the concept of Autoencoders and GAN.
22CDS643.6	Implement Deep learning models for Real-world applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Fundamentals of Deep Learning	Nikhil Buduma	O'Reilly Media	1st Edition, 2017
2	Neural Networks and Deep Learning	Charu C Aggarwal	Springer	2nd Edition, 2018
Reference Books				
1	Hands on Machine Learning with Scikit-Learn & TensorFlow	AurelienGeron	O'Reilly	1st Edition, 2019
2	Deep Learning	Lan Good fellow and Yoshua Bengio	MIT Press	2nd Edition, 2016

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs13/
- https://www.youtube.com/watch?v=5ZmFlxrNaN8&list=PLBlnK6fEyqRjT3oJxFXRgjPNzeS-LFY-q
- https://www.youtube.com/watch?v=Qkwj65l_96I&list=PLEbnTDJUr_IcPtUXFy2b1sGRPsLFMghhS
- https://www.youtube.com/playlist?list=PLXj4XH7LcRfC9pGMWuM6UWE3V4YZ9TZzM
- https://www.youtube.com/playlist?list=PLENQMW_c1dimxHUu6KjuBC2rOlAaoLozF

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS643.1	2													
22CDS643.2			1										1	
22CDS643.3			2										1	
22CDS643.4			2										1	
22CDS643.5			2											
22CDS643.6		2									1		1	

1: Low 2: Medium 3: High

Industrial and Medical IOT			
Course Code	**22CDS644**	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 provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.
- Knowledge for the design and analysis of Industrial and medical Systems.
- Redefining healthcare by ensuring better healthcare, bridging the skills gap in the industry and ensuring career advancement.
- To implement real field problem by gained knowledge of Industrial applications with IoT capability.

Module-1: Introduction to Industrial IoT **8 hours**

Introduction to Industrial IoT: Technical requirements, IoT Background-History and definition, IoT enabling factors, IoT applications, IoT key technologies, I-IoT, IoT and I-IoT – similarities and differences, IOT analytics and AI, Industry environments and scenarios covered by I-IoT.

Protecting the privacy of IOT based healthcare records using block chain technology: Introduction, blockchain, proposed model.

TB1: Ch-1, TB2: Ch-3

Module-2 : Industrial Process and Devices Technical Requirements **8 hours**

Understanding the Industrial Process and Devices Technical requirements: The industrial process-Automation in the industrial process, Control and measurement systems, Types of industrial processes, The I-IoT dataflow.

Medical data compression for lossless data transmission: Introduction to medical data compression, data compression techniques for lossless data transmission, comprehensive algorithms for medical data compression.

TB1: Ch-2 TB2: Ch-4

Module-3 : Industrial Data Flow and Devices **8 hours**

Industrial Data Flow and Devices: Technical requirements, The I-IoT data flow in the factory, Measurements and the actuator chain. Sensors, The converters - Digital to analogical, Analog to digital, Actuators, Controllers - Microcontrollers, Embedded microcontrollers, Microcontrollers with external memory, DSP's. Industrial protocols -Automation networks, the fieldbus, Developing Industrial IoT and Architecture Introduction to the I-IoT platform and architectures, OSGi, micro service, containers, and server less computing, The standard IIoT flow.

Wearable smart devices: remote healthcare monitoring.

TB1: Ch-3, 4, 7 TB2: Ch-5

Module-4 : Internet of Medical Things Introduction and System Architecture **8 hours**

Implementing a cloud industrial IOT solution with google cloud, technical requirements, Google cloud requirements, Smart assistance of elderly individuals in emergency situations at home: Introduction, IoT for elderly people, We-Watch wrist band. Smart wearable devices: Introduction, wearable smart devices for remote healthcare monitoring, Fabric based werables.

TB1: Ch-11, TB2: Ch-6, 7

Module-5 : Security Measures in IOT Systems using Machine and Deep Learning Techniques **8 hours**

Introduction, Threats in IOT security, Applications of machine learning and deep learning in IoT security, advantages of deep learning over classical data mining, challenges, issues and future directions. Machine learning with IoMT: opportunities and research challenges, introduction, machine learning for data analytics, ML/DL methods for IoT security.

Course Outcomes: At the end of the course the student will be able to:	
22CDS644.1	Discuss the basics of Industrial IOT and Medical IOT
22CDS644.2	Identify the technical and industrial requirement procedures for IIOT applications
22CDS644.3	Develop various applications using IIOT architectures
22CDS644.4	Choose selected IOT devices for understanding the system architecture of medical IOT
22CDS644.5	Analyze privacy and security measures for industry and medical standard solutions
22CDS644.6	Developing innovative and cost-effective embedded solutions for the electronics and manufacturing industries

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0	Veneri, Giacomo, and Antonio Capasso	Packt Publishing Ltd	1st Edition, 2018
2	Internet of Medical Things Remote Healthcare Systems and Applications	D. Jude Hemanth and J. Anitha George A. Tsihrintzis	Springer	1st Edition, 2021
Reference Books				
1	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Apress	1st Edition, 2017
2	Internet of Things and advanced application in Healthcare	Reis, Catarina I., and Marisa da Silva Maximiano, eds	IGI Global	1st Edition, 2016

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/specializations/developing-industrial-iot#courses
- https://www.coursera.org/learn/industrial-internet-of-things.
- https://www.coursera.org/learn/internet-of-things-sensing-actuation
- https://www.youtube.com/watch?v=JN8uv-qryRY
- https://www.youtube.com/watch?v=FNPHkFTy8YI

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS644.1	2													
22CDS644.2	3													
22CDS644.3	3		3										3	3
22CDS644.4	3													
22CDS644.5		3												
22CDS644.6	3		3											

1: Low 2: Medium 3: High

Introduction to AI and ML			
Course Code	**22CDS651**	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 objectives of the course is

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving.
- Familiarize with the basics of Machine Learning & Machine Learning process.
- Understand the basics of Decision Tree and probability learning.
- Understand the working of Artificial Neural Networks and basic concepts of clustering algorithms.

Module-1: What is 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 : Searching and Solving **8 hours**

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

TB 1: Ch- 3

Module-3 : Why do we need 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.
Similarity-based learning: Introduction to Similarity or instance based learning, Nearest-neighbor learning, weighted k- Nearest - Neighbour algorithm

TB 2: Ch-1, 2

Module-4 : Understanding the Data **8 hours**

Understanding Data-I: What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization
Understanding Data-II: Bivariate and Multivariate data, Multivariate statistics , Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques

TB 2: Ch-2, 3 and 4

Module-5 : Neural Networks **8 hours**

Artificial Neural Network: Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network, learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map

TB 2: Ch-10

Course Outcomes: At the end of the course the student will be able to:	
22CDS651.1	Apply the knowledge of searching and reasoning techniques for each application
22CDS651.2	Comprehend basic understanding of machine learning in relation to other fields and fundamental issues and challenges of machine learning.
22CDS651.3	Apply the knowledge of classification algorithms on various dataset and compare results.

22CDS651.4	Examine the neuron and Neural Network, and to analyze ANN learning and its applications.
22CDS651.5	Identify the suitable clustering algorithm for different pattern.
22CDS651.6	Compare 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: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	4th Edition, 2020
2.	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber, Jian Pei	MIT Press	3rd Edition, 2011
Reference Books				
1.	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	1st Edition, 2016
2.	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	1st Edition, 2012

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

	PO1	**PO2**	**PO3**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CDS651.1			1	3									3
22CDS651.2					3								3
22CDS651.3					1								
22CDS651.4				3	2								3
22CDS651.5			2										
22CDS651.6			2		1								3

1: Low 2: Medium 3: High

Introduction to Data Science			
Course Code	**22CDS652**	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

- Introduce data collection and pre-processing techniques for data science.
- Explore analytical methods for solving real life problems through data exploration techniques.
- Illustrate different types of data and its visualization.
- Find different data visualization techniques and tools.
- Design and map elements of visualization well to perceive information

Module-1: Preparing and Gathering **8 hours**

Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data.
TB 1: Ch-1

Module-2 :The Data Science Process **8 hours**

Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.
TB 1: Ch-2

Module-3 : Machine Learning **8 hours**

Application for machine learning in data science- Tools used in machine learning Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.
TB 1: Ch-3

Module-4 : Visualization **8 hours**

Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.
TB 1: Ch-9

Module-5 : Big Data **8 hours**

The Big data Ecosystem: Distributed file system, Distributed Programming framework, Data Integration framework, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security. Distributing data storage and processing with frameworks - **Case study**: e.g, Assessing risk when lending money
TB 1: Ch-5

Course Outcomes: At the end of the course the student will be able to:	
22CDS652.1	Explain the data science terminologies.
22CDS652.2	Describe the Data Science process on real time scenario
22CDS652.3	Apply data visualization tools
22CDS652.4	Apply Data storage and processing with frameworks.
22CDS652.5	Identify various branches in Data Science.
22CDS652.6	Apply Data Science tools for real-life applications.

Web links and Video Lectures (e-Resources):

- https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science
- https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science tPgFU
- Learn Data Science Tutorial - Full Course for Beginners - YouTube
- https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introducing Data Science	Davy Cielen, ArnoD. B. Meysman and Mohamed Ali	Manning Publications	1st Edition, 2016
Reference Books				
1	Doing Data Science	Cathy O'Neil, Rachel Schutt, O' Reilly	O'Reilly Media	1st Edition, 2013
2	Think Like a Data Scientist	Brian Godsey	Manning Publications	1st Edition, 2017
3	Mining of Massive Datasets	Jure Leskovec, Anand Rajaraman, Jeffrey DavidUllman	Cambridge University Press	2nd Edition, 2014

Course Articulation Matrix

	PO1	PO2	PO3	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS652.1	2			2	3								
22CDS652.2				2		3							
22CDS652.3				3									
22CDS652.4				3		1							
22CDS652.5				2	2							2	
22CDS652.6				2	2							3	

1: Low 2: Medium 3: High

Introduction to Computer Vision			
Course Code	**22CDS653**	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

- Understand the fundamentals of digital image processing.
- Understand the image enhancement techniques used in digital image processing.
- Learn the image restoration techniques, Morphological Operations and Segmentation used in digital image processing.
- Apply the digital image processing techniques in real-time captured images.

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:	
22CDS653.1	Describe the fundamental image processing techniques required for computer vision.
22CDS653.2	Explain Image formation process.
22CDS653.3	Identify appropriate object recognition and shape analysis techniques.
22CDS653.4	Compare different segmentation techniques.
22CDS653.5	Make use of image registration techniques.
22CDS653.6	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	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
2	Computer Vision: Models, Learning, and Inference	Simon J. D. Prince	Cambridge University Press	1st Edition, 2012

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 Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22CDS653.1	2											2		2
22CDS653.2		2	2										2	
22CDS653.3						2						2		
22CDS653.4		2	2	2	2	1	2	1						
22CDS653.5				1	2	1			1	2	2			
22CDS653.6			1		1				2	2	2			2

1: Low 2: Medium 3: High

Predictive Analytics			
Course Code	**22CDS654**	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, to develop prediction models using techniques like neural networks, decision trees, and logistic regression.
- To know the use of the binary classifier and numeric predictor nodes to automate model selection.
- To advice on when and how to use each model. Also 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, **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 Learning classifiers **(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:

22CDS654.1	Demonstrate the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
22CDS654.2	Compare the underlying predictive modeling techniques.
22CDS654.3	Select appropriate predictive modeling approaches to identify cases.

22CDS654.4	Apply predictive modeling approaches using a suitable package such as SPSS Modeler.
22CDS654.5	Visualize and explore data to better understand relationships among variables.
22CDS654.6	Assess performance of models with holdout data & 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, 2009	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	1st edition, 2006
2	All of statistics	L.Wasserman	Springer	1st edition, 2004
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**
22CDS654.1	1												1	
22CDS654.2	2	1		1										
22CDS654.3	1	2		1									2	1
22CDS654.4													2	1
22CDS654.5	1	3			3								1	2
22CDS654.6		1	1					1	1	2				1

1: Low 2: Medium 3: High

Major Project Phase I			
Course Code	**22CDS66**	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 :	
22CDS66.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
22CDS66.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
22CDS66.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
22CDS66.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.

22CDS66.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
22CDS66.6	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
22CDS66.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22CDS66.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22CDS66.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
22CDS66.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
22CDS66.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
22CDS66.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**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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