



TAKSHASHILA UNIVERSITY

(Tamil Nadu State Private University)

ONGUR, TINDIVANAM TK, VILLUPURAM DT

FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTATIONAL ENGINEERING

Department of Computer Science and Engineering

REGULATION - R23

CURRICULUM & SYLLABI

B.Tech - CSE

Semester – VII



VISION AND MISSION OF UNIVERSITY

VISION:

To create change makers and world leaders similar to the ancient Takshashila University

MISSION:

The brightest minds and the best resources are used to nurture and develop the leaders of tomorrow, where they are encouraged to be eternally curious and ethically sound.

DEPARTMENT VISION AND MISSION

VISION:

To be a center of excellence in Computer Science and Engineering through quality education, innovation, and research, producing ethical professionals to meet global and societal needs

MISSION:

M1: Quality Education	Deliver quality education through outcome-based learning and modern teaching practices.
M2: Innovation and Research	Foster innovation, research, and industry collaboration to solve real-world problems.
M3: Career Development	Enhance employability and entrepreneurship through skill development and experiential learning.
M4: Ethics and Social Responsibility	Promote professionalism, ethical values, leadership, and lifelong learning.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis

Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: 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.

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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 leader in a team, to manage projects and in multidisciplinary environments.

PO12: 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 EDUCATIONAL OBJECTIVES (PEOs)**PEO1: Career Excellence**

Build successful careers in industry, academia, research, or entrepreneurship.

PEO2: Innovation

Develop innovative and sustainable computing solutions.

PEO3: Professionalism

Demonstrate ethics, leadership, teamwork, and effective communication.

PEO4: Lifelong Learning

Adapt to emerging technologies through continuous learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)**PSO1: Software Development**

Design and develop efficient software solutions using modern computing techniques.

PSO2: Emerging Technologies

Apply emerging computing technologies and modern tools to develop intelligent and scalable solutions for real-world problems.

PSO3: Professional Practice

Demonstrate innovation, technical competence, ethical responsibility, and effective communication.



**TAKSHASHILA
UNIVERSITY**

(Established Under Tamil Nadu State Private Universities Act 2019 &
Recognized by UGC u/s 2(f) of the UGC Act, 1956)

Ongur (PO), Tindivanam Taluk, Villupuram District,
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Faculty of Engineering and Technology
B.Tech. in Computer Science and Engineering
(REGULATION – R23)

SEMESTER – VII

Sl. No.	Course Code	Course Title	Cate gory	Periods			Cre dits	Hrs.	Max. Marks								
				L	T	P			CAT (Best of two)	ASS	MCQ	ATT	SEM	PRAC	CAM	ESM	Total
1	U23CE7T01	Wireless Sensor Networks	PC	3	0	0	3	45	20	5	5	5	5	-	40	60	100
2	U23AD7T02	Edge Analytics	PC	3	0	0	3	45	20	5	5	5	5	-	40	60	100
3	U23CE7T03	Software Development and IT Operations	PC	3	0	0	3	45	20	5	5	5	5	-	40	60	100
4	U23**7T**	Professional Elective – IV	PE	3	0	0	3	45	20	5	5	5	5	-	40	60	100
5	U23MB7T**	Open Elective-IV	OE	3	0	0	3	45	20	5	5	5	5	-	40	60	100
Total:							15	225							200	300	500
6	U23CE7W01	Project Phase-I	PW	0	0	12	6	180	-	-	-	-	-	-	50	50	100
Total:							6	180							50	50	100
7	U23UM7P31	Takshashila Innovative Learning -VII	TIL	0	0	2	1	30	-	-	-	-	-	-	100	-	100
8	U23UM7P32	Critical Thinking	CT	0	0	2	1	30	-	-	-	-	-	-	100	-	100
9	U23UM7P33	Green Credit -VII	GC	0	0	2	1	30	-	-	-	-	-	-	100	-	100
Total:							3	90							300	-	300
Semester Total:							24	495							550	350	900

Note:

L - Lecture

ATT - Attendance

CAT - Continuous Assessment Test

ESM – End Semester Exam Marks

ASS - Assignment

P - Practical

SEM - Seminar

T - Tutorial

CAM - Continuous Assessment Marks

PW - Project

BoS Chairman

U23CE7T01	Wireless Sensor Networks	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

• To describe the architecture, components, and applications of Wireless Sensor Networks (WSNs) using Contiki OS
• To examine wireless transmission, synchronization, and localization techniques in Wireless Sensor Networks (WSNs)
• To apply Medium Access Control (MAC) protocols for energy-efficient communication using Contiki OS
• To analyze routing protocols through simulation using the Cooja simulator
• To assess middleware, operating systems, and security mechanisms in Wireless Sensor Networks (WSNs)

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Understand the architecture, components, and applications of Wireless Sensor Networks (WSNs) using Contiki OS.
CO2 :	Apply wireless communication, synchronization, and localization techniques in Wireless Sensor Networks (WSNs).
CO3 :	Evaluate and implement energy-efficient MAC protocols using Contiki OS.
CO4 :	Design and simulate routing protocols for Wireless Sensor Networks (WSNs) using the Cooja simulator.
CO5 :	Analyze middleware architectures, operating systems, and security mechanisms in Wireless Sensor Networks (WSNs).

UNIT I : Introduction Wireless Sensor Networks	9 Hrs.
Introduction to computer and wireless sensor Networks-Motivation for a network of Wireless Sensor Nodes-Sensing and Sensors-Challenges and Constraints-Node Architecture-Sensing Subsystem-Processor Subsystem-Communication Interfaces-Prototypes-Applications of wireless sensors-WSN Tools-Overview and limitations-Contiki-Introduction-Characteristics of Contiki WSN simulator.	

UNIT II : Wireless Transmission Technology	9 Hrs.
Wireless transmission technology and Systems-Radio Technology Primer-Available wireless Technologies-Hardware-TelosB hardware-MicaZ Motes-Time Synchronization-Clock-Synchronization Problems-Basics of time Synchronization-Time synchronization Protocols-Localization-Ranging Techniques-Range-based Localization-Range-free Localization-Event-driven localization.	

UNIT III : Overview Wireless Mac Protocols	9 Hrs.
Overview-Wireless MAC Protocols-Characteristics of MAC protocols in sensor Networks-Contention-free MAC protocols-MAC protocol Characteristics-Traffic Adaptive Medium Access (TRAMA)-Y-MAC-Low Energy Adaptive Clustering Hierarchy (LEACH)-Contention-based MAC Protocols-Sensor MAC (S-MAC)-Timeout MAC (T-MAC)-Pattern MAC-MAC protocols in Contiki OS simulator-NullMAC in Contiki simulator-CSMA in Contiki simulator.	

UNIT IV : Design Issues in WSN Routing	9 Hrs.
Design issues in WSN routing-Data dissemination and gathering-Routing challenges in WSN-Flooding-Flat-based routing-SAR-Directed Diffusion-MCFA-Coherent processing-Non-coherent processing-Hierarchical routing-LEACH-TEEN-APTEEN-PEGASIS-Query-based routing-Negotiation-based routing-Geographical-based routing-Routing protocol simulation in Contiki-RPL objective function and simulation using DGRM model in Cooja-RPL (Routing Protocol for Low-Power and Lossy Networks) Border Router simulation in Contiki 2.7 O.	

UNIT V - WSN Middleware Principles	9 Hrs.
WSN middleware Principles-Middleware Architecture-Data-related Functions-Architecture-Existing middleware-MiLAN-IrisNet-AMF-DSWare-CLMF-Operating systems for wireless sensor networks-Performance and traffic management-Fundamentals of network security-Network security challenges-Attacks-Protocols and mechanisms for security.	

TEXT BOOKS:	
1.	Hossam Mahmoud Ahmad Fahmy, "Concepts, Applications, Experimentation and Analysis of Wireless Sensor Network", Springer, 2023.
2.	Samayveer Singh, "IoT-enabled Sensor Networks: Architecture, Methodologies, Security, and Futuristic Applications", Bentham Science, 2024.

REFERENCE BOOKS :	
1.	Bhanu Chander, "Intelligent Wireless Sensor Networks and the Internet of Things: Algorithms, Methodologies, and Applications", CRC Press, 2024.
2.	Ajay Prasad, Thipendra P. Singh, Samidha Dwivedi Sharma, "Communication Technologies and Security Challenges in IoT: Present and Future", Springer, 2024.

WEB REFERENCES :	
1.	https://docs.contiki-ng.org/
2.	https://datatracker.ietf.org/doc/html/rfc6550
3.	https://docs.contiki-ng.org/en/master/doc/tutorials/Running-Contiki-NG-in-Cooja.html
4.	https://ieeexplore.ieee.org/document/11008746

COs/POs/PSOs Mapping :															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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3	3	3	3	2	3	-	1	-	-	1	-	1	3	3	1
4	3	3	3	3	3	-	1	1	1	1	1	2	3	3	2
5	3	2	2	3	2	3	1	-	1	2	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation




BoS Chairman

U23AD7T02	Edge Analytics	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To introduce the fundamentals of Edge Computing
• To explore Deep Learning for Edge applications
• To understand Deep Reinforcement Learning techniques
• To learn Edge Computing tools and technologies
• To apply Edge Analytics in smart IoT and healthcare applications

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain IoT sensing technologies, mobile systems, and cognitive computing in Edge Computing.
CO2 :	Apply Deep Learning techniques for Edge Computing applications.
CO3 :	Implement Deep Reinforcement Learning algorithms for intelligent edge systems.
CO4 :	Develop Edge Computing applications using modern Edge development tools.
CO5 :	Design and Analyze Edge Analytics solutions for smart healthcare applications.

UNIT I : IoT Sensing, Mobile and Cognitive Systems	9 Hrs.
Sensing Technologies for Internet of Things (IoT) – IoT interactions with GPS, Cloud and Smart Machines – Global Positioning Technologies – Cloud-centric IoT Applications – IoT Interaction Frameworks – Radio Frequency Identification (RFID) – IoT System Architecture – IoT-enabled Supply Chain Management – Sensors and Wireless Sensor Networks – GPS Systems – Cognitive Computing Technologies – Prototype Systems.	

UNIT II : Deep Learning with Artificial Neural Networks	9 Hrs.
Deep Learning and Human Intelligence – Biological Neurons vs. Artificial Neurons – Deep Learning vs. Shallow Learning – Artificial Neural Networks – Single-layer and Multi-layer Neural Networks – Forward Propagation – Backpropagation – Autoencoders – Stacked Autoencoders – Deep Belief Networks – Restricted Boltzmann Machines – Convolutional Neural Networks (CNN) – Convolution and Pooling Operations – Deep CNN Architectures – Advanced Deep Learning Networks.	

UNIT III : Deep Reinforcement Learning	9 Hrs.
Introduction to Reinforcement Learning – Dynamic Programming – Monte Carlo Methods – Markov Decision Processes – Multi-Armed Bandits – Deep Q Networks (DQN) – Q-Learning – Policy Gradient Methods – REINFORCE Algorithm – Actor-Critic Methods – Distributed Reinforcement Learning – Advanced Deep Reinforcement Learning Algorithms.	

UNIT IV : Edge Tools	9 Hrs.
Azure IoT Edge Architecture – Azure IoT Hub – Containers and Modules – Edge Agent and Edge Hub – Device Twins and Module Twins – Edge Message Routing – Edge Device Security – Azure IoT Edge Deployment – Development Environment – Visual Studio Code for IoT Edge – Docker – IoT Edge Emulator – Azure IoT Edge SDK – Creating Edge Solutions using Visual Studio Code.	

UNIT V : Edge Analytics in Healthcare Applications	9 Hrs.
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Healthcare Monitoring Systems – IoT-enabled Healthcare Applications – Chronic Disease Detection – Software Libraries for Healthcare Analytics – Big Data Analytics in Healthcare – Predictive Analytics for Disease Detection – Performance Evaluation of Disease Detection Models – Emotion Recognition using IoT and Cloud – 5G-enabled Cloud-centric Healthcare Systems.

TEXT BOOKS:

- | | |
|----|--|
| 1. | Kai Hwang and Min Chen, “Big-Data Analytics for Cloud, IoT and Cognitive Computing”, John Wiley & Sons Ltd., 2017. |
| 2. | Alexander Zai and Brandon Brown, “Deep Reinforcement Learning in Action”, Manning Publications, First Edition, 2020. |
| 3. | David Jensen, “Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge”, Apress, 2019. |

REFERENCE BOOKS:

- | | |
|----|---|
| 1. | Zaigham Mahmood, “Fog Computing: Concepts, Frameworks and Technologies”, Springer, 2018. |
| 2. | Maria Gorlatova, “OpenFog Consortium Architecture Working Group, OpenFog Reference Architecture for Fog Computing, OpenFog Consortium”, 2017. |
| 3. | Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press, 2017. |
| 4. | Rajkumar Buyya and Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, John Wiley & Sons, 2019. |
| 5. | D. Jude Hemanth and Valentina Emilia Balas, “Artificial Intelligence Techniques for Edge Computing”, Academic Press (Elsevier), 2020. |

WEB REFERENCES:

- | | |
|----|---|
| 1. | https://learn.microsoft.com/azure/iot-edge |
| 2. | https://developers.google.com/edge/ai-edge-portal |
| 3. | https://nptel.ac.in/courses/106106224 |
| 4. | https://pytorch.org/tutorials/intermediate/reinforcement_q_learning.html |

COs/POs/PSOs Mapping :

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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5	3	3	3	3	2	2	1	2	1	1	–	2	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, ‘-’ - no correlation

BoS Chairman

U23CE7T03	Software Development and IT Operations	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

• To introduce DevOps principles, lifecycle, and real-world applications.
• To explain version control, CI/CD tools, and workflows.
• To explore containerization and orchestration using Docker and Kubernetes.
• To examine deployment, monitoring, and logging in cloud environments.
• To understand DevSecOps and automation for secure, scalable delivery.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain DevOps concepts and compare with SDLC and Agile.
CO2 :	Use Git and CI/CD tools for automated development workflows.
CO3 :	Deploy and manage containers with Docker and Kubernetes.
CO4 :	Implement monitoring and logging in cloud-native systems.
CO5 :	Apply DevSecOps and automation tools for secure pipelines.

UNIT I : Introduction to DevOps	9 Hrs.
Introduction to DevOps – Traditional SDLC vs Agile vs DevOps – DevOps lifecycle – DevOps principles – Culture and collaboration – Benefits and challenges – Key DevOps tools overview – Case studies of DevOps in real-world applications.	

UNIT II : Version Control and Ci/Cd Fundamentals	9 Hrs.
Version Control with Git – Git operations: init, clone, commit, push, pull, branch, merge – GitHub and GitLab workflows – Build tools: Maven, Gradle – Introduction to Continuous Integration – Jenkins: setup, pipeline creation – CI/CD principles and use cases.	

UNIT III : Containerization and Orchestration	9 Hrs.
Docker: architecture, images, containers, volumes – Docker Compose – Container lifecycle – Kubernetes: architecture, pods, services, deployments – YAML configuration – Basic orchestration tasks – Containerization vs Virtualization – Docker and Kubernetes integration.	

UNIT IV : Deployment, Monitoring and Logging	9 Hrs.
Cloud platforms overview (AWS, Azure, GCP) – Infrastructure as Code (IaC): basics of Terraform – Monitoring tools: Prometheus, Grafana – Logging with ELK Stack – Deployment strategies: blue-green, rolling, canary – DevOps in cloud-native applications.	

UNIT V : DevSecOps and Automation Practices	9 Hrs.
DevSecOps fundamentals – Secure CI/CD pipelines – Secrets and configuration management – Automation with Ansible – Configuration management basics – Performance optimization – Best practices and tools for DevOps security – DevOps trends and future directions.	

Total Hours: 45

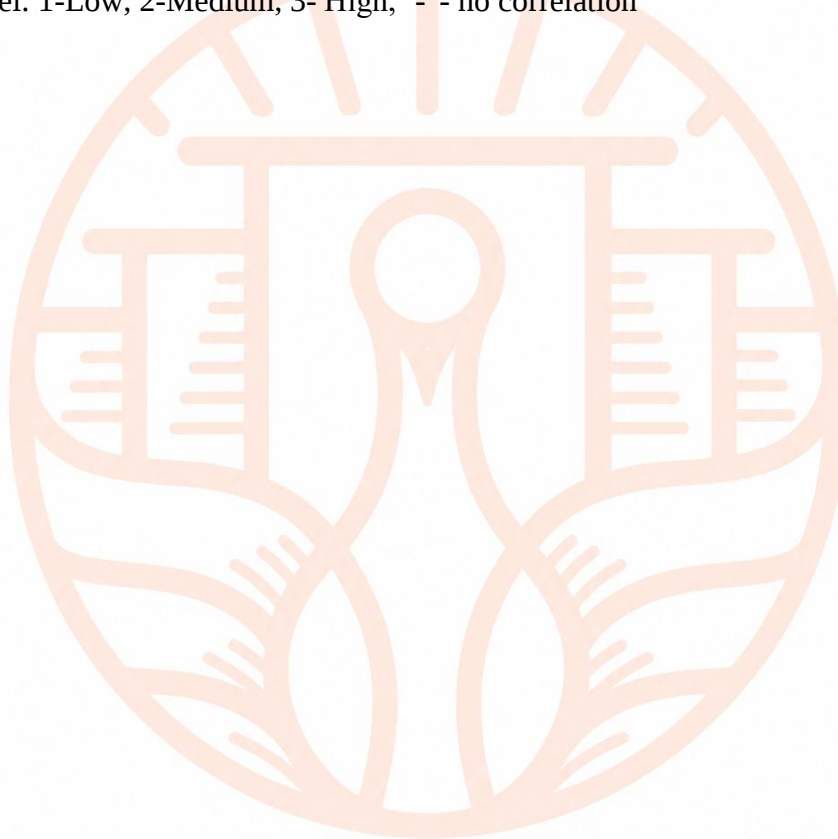
TEXT BOOKS :	
1.	Gene Kim, Jez Humble, Patrick Debois, and John Willis, The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, 2nd Edition, IT Revolution Press, 2021.
2.	Nicole Forsgren, Jez Humble and Gene Kim, Accelerate: The Science of Lean Software and DevOps, 1st Edition, 2018.
3.	Gene Kim, Kevin Behr, George Spafford : The Phoenix Project, 5th Edition, 2018

REFERENCE BOOKS :	
1.	Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Addison-Wesley Professional, 2010.
2.	Brendan Burns, Joe Beda, and Kelsey Hightower, Kubernetes Up and Running: Dive into the Future of Infrastructure, 3rd Edition, O'Reilly Media, 2022.
3.	Jeff Geerling, Ansible for DevOps: Server and Configuration Management for Humans, Lean Publishing, 2020.
4.	Jennifer Davis, Katherine Daniels: Effective DevOps, 1st Edition, 2016.
5.	Mirco Hering: DevOps for the Modern Enterprise, 1st Edition, 2018.

WEB REFERENCES :	
1.	https://docs.cloud.google.com/architecture/devops
2.	https://www.atlassian.com/devops/devops-tools
3.	https://devopsyard.com/
4.	https://learn.microsoft.com/en-us/azure/devops/?view=azure-devops
5.	https://docs.github.com/en/actions

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Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation



BoS Chairman

PROFESSIONAL ELECTIVE COURSES

Professional Elective – II (Offered in Semester VII)		
Sl. No.	Course Code	Course Title
1.	U23CE7T21	Cognitive Computing
2.	U23CE7T22	Ethical Hacking
3.	U23AD7T21	Data Mining and Business Intelligence
4.	U23AD7T22	Text And Speech Analysis
5.	U23AD7T23	Reinforcement Learning
6.	U23ML7T21	AI in Healthcare
7.	U23ML7T22	Machine Learning for Cybersecurity



BoS Chairman

U23CE7T21	Cognitive Computing	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand the fundamentals and architecture of cognitive computing systems.
• To apply NLP, Generative AI, and machine learning techniques for intelligent applications.
• To analyze big data technologies for cognitive decision-making.
• To explore cognitive computing applications in business and automation.
• To evaluate cognitive computing solutions in healthcare, smart cities, and emerging domains.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain the fundamentals, architecture, and applications of Cognitive Computing.
CO2 :	Apply basic NLP and Generative AI techniques for information processing.
CO3 :	Analyse data using Big Data technologies and cognitive computing concepts.
CO4 :	Evaluate cognitive computing solutions for business intelligence and automation.
CO5 :	Develop simple cognitive applications for healthcare, smart cities, and related domains.

UNIT I : Introduction To Cognitive Computing	9 Hrs.
Introduction to Cognitive Computing – Evolution of Artificial Intelligence – Characteristics of Cognitive Systems – Human Intelligence and Machine Intelligence – Components of Cognitive Computing Systems – Data Collection and Knowledge Discovery – Basics of Machine Learning – Cognitive Reasoning and Decision Making – Explainable AI (XAI) – Applications of Cognitive Computing in Various Domains.	

UNIT II : Natural Language Processing And Generative Ai	9 Hrs.
Introduction to Natural Language Processing (NLP) – Text Processing Techniques – Information Extraction – Sentiment Analysis – Conversational AI and Chatbots – Introduction to Large Language Models (LLMs) – Generative AI Concepts and Applications – Prompt Engineering Basics – Cognitive Search Systems – Applications of NLP in Business and Society.	

UNIT III : Big Data And Cognitive Systems	9 Hrs.
Introduction to Big Data – Characteristics of Big Data (5Vs) – Sources of Big Data – Data Warehousing and Data Lakes – Hadoop Ecosystem Overview – Apache Spark Fundamentals – Data Processing and Analytics – Real-Time Data Processing Concepts – Role of Big Data in Cognitive Computing – Data-Driven Decision Making – Open-Source Big Data Tools and Applications.	

UNIT IV : Cognitive Computing For Business Applications	9 Hrs.
Business Intelligence Fundamentals – Cognitive Analytics – Intelligent Decision Support Systems – Automation and Cognitive Technologies – Customer Analytics – Recommendation Systems – Applications in Marketing, Banking, Retail, and Supply Chain Management – Ethical Issues in AI – Responsible Use of Cognitive Systems – Emerging Trends in Business Applications.	

UNIT V - Applications In Cognitive Computing	9 Hrs.
Introduction to Cognitive Healthcare – Clinical Decision Support Systems – Healthcare Data Analytics – Predictive Healthcare Concepts – AI-Based Patient Monitoring – Smart City Fundamentals – IoT and Cognitive Computing – Intelligent Transportation Systems – Smart Governance – Sustainable Development through Cognitive Technologies – Future Trends and Challenges.	

Total Hours: 45

TEXT BOOKS :	
1.	Debmalya Barh, Janitza Montalvo and Vasco Azevedo, Artificial Intelligence, Machine Learning and Cognitive Computing for Healthcare, Education and Industry, Academic Press (Elsevier), 2020.
2.	Judith Hurwitz, Marcia Kaufman, and Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley, 2015.
3.	Daniel Jurafsky, James H. Martin, Speech and Language Processing, 3rd Edition, 2025.

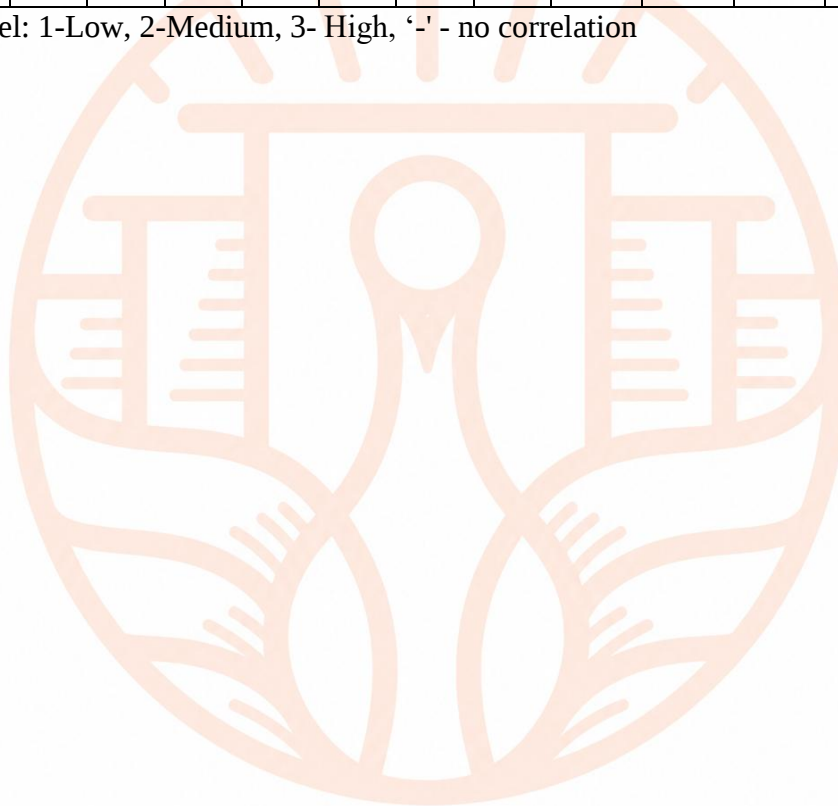
REFERENCE BOOKS :	
1.	Michael J. Kavis, Architecting Cognitive AI Systems, Wiley, 2022.
2.	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
3.	Anand Raman, Cognitive Computing Recipes: Artificial Intelligence Solutions Using Microsoft Cognitive Services and TensorFlow, 1st Edition, 2018.
4.	Prateek Joshi, Hands-On Cognitive Computing with Python, 1st Edition, 2019.
5.	Tanmay Bakshi, Mastering Cognitive Computing with IBM Watson, 1st Edition, 2018.

WEB REFERENCES :	
1.	https://www.ibm.com/topics/cognitive-computing
2.	https://web.stanford.edu/class/cs224n
3.	https://aws.amazon.com/what-is/cognitive-computing
4.	https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-cognitive-ai
5.	https://wizape.com/English/Applications-of-Cognitive-Computing

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4	2	3	3	2	3	2	2	2	2	2	2	2	3	3	3
5	3	3	3	2	3	3	2	1	2	3	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation




BoS Chairman

U23CE7T22	Ethical Hacking	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand ethical hacking, penetration testing, and cybersecurity fundamentals
• To apply information gathering and scanning techniques for security assessment
• To analyze network attacks, vulnerabilities, and exploitation techniques
• To evaluate wireless and web application security vulnerabilities
• To recommend security controls and risk mitigation strategies

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain ethical hacking and penetration testing concepts.
CO2 :	Apply information gathering and scanning techniques for security assessment.
CO3 :	Analyze network attacks and security vulnerabilities.
CO4 :	Evaluate exploitation, wireless, and web application vulnerabilities.
CO5 :	Recommend security controls and risk mitigation strategies.

UNIT I : Fundamentals of Ethical Hacking and Penetration Testing	9 Hrs.
Introduction to Hacking –Important Terminologies – Hacktivism – Computer Crimes and Implications. Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement–Penetration Testing Methodologies: OSSTMM–NIST –OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports.	

UNIT II : Information Gathering and Scanning	9 Hrs.
Information Gathering Techniques: Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute: ICMP, TCP and UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.	

UNIT III : Network Attacks	9 Hrs.
Network Sniffing – Types of Sniffing – Promiscuous versus Non promiscuous Mode – MITM Attacks – ARP Attacks –MAC flooding - Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation –Attacking Network Remote Services – Attacking SMTP –Attacking SQL Servers – Testing for Weak Authentication.	

UNIT IV : Exploitation	9 Hrs.
Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E-Mails with Malicious Attachments – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–	

Exploitation – Cracking the Hashes: Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.

.UNIT V : Wireless And Web Hacking	9 Hrs.
Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircracking – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Log-In Protection Mechanisms – Captcha Validation Flaw –Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability– Session Attacks – SQL Injection Attacks.	

Total Hours: 45

TEXT BOOKS :	
1.	The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, Patrick Engebretson, Elsevier (Syngress), 3rd Edition, 2021.
2.	Hands-On Ethical Hacking and Network Defense, Michael T. Simpson, Kent Backman and James Corley, Cengage Learning, 4th Edition, 2022.

REFERENCE BOOKS :	
1.	Ethical Hacking: A Hands-on Introduction to Breaking In, Daniel G. Graham, No Starch Press, 2021.
2.	Penetration Testing: A Hands-On Introduction to Hacking, Georgia Weidman, No Starch Press, Updated Reprint, 2021.
3.	Hacking Exposed: Network Security Secrets and Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill Education, 8th Edition, 2018.
4.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz and Tim Arnold, No Starch Press, 2nd Edition, 2021.
5.	Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, Wiley, 2nd Edition (Reprint), 2022.

WEB REFERENCES :	
1.	https://portal.offsec.com/explore/all-content/category-31/attack-3183?mySubscriptionsFlag=false&sortBy=createdAt:desc
2.	https://owasp.org/Top10/2025/
3.	https://attack.mitre.org/tactics/TA0042/
4.	https://docs.rapid7.com/metasploit/
5.	https://csrc.nist.gov/

COs/POs/PSOs Mapping :															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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2	3	3	2	3	3	2	2	–	1	1	1	2	2	3	2
3	3	3	2	3	3	2	2	–	1	2	1	2	3	3	2
4	3	3	3	3	3	2	2	1	2	2	2	2	3	3	3
5	3	3	3	2	3	3	2	2	2	3	2	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation



BoS Chairman

U23AD7T21	Data Mining and Business Intelligence	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

- To understand the fundamentals of data mining, business intelligence, and data warehousing concepts for organizational decision-making
- To analyze data preprocessing techniques and data warehouse design for efficient data storage and management
- To understand data mining methodologies, classification techniques, predictive modeling, and model evaluation methods for developing accurate and reliable data mining models.
- To implement predictive analytics methods and business intelligence tools for effective data visualization and decision support
- To apply advanced data mining techniques, optimization methods, and their applications in solving real-world business problems

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the fundamentals of data mining, business intelligence, and data warehousing.
CO2:	Apply data preprocessing techniques and data warehousing concepts to manage data effectively.
CO3:	Apply data mining methodologies, classification algorithms, and model evaluation techniques to build and validate predictive models effectively.
CO4:	Analyze business data using predictive analytics, visualization, and business intelligence tools.
CO5:	Implement advanced data mining and machine learning techniques to solve real-world business problems.

UNIT I: Introduction to Data Mining and Business Intelligence	9 Hrs.
Data mining - Data Mining Functionalities - Classification of Data Mining Systems - Major Issues in Data Mining - Knowledge Discovery in Databases (KDD) - Data Mining Process - Data Types and Data Sources - Business Intelligence Fundamentals - Decision Support Systems - Data Warehousing Concepts - Applications of Data Mining and BI.	

UNIT II: Data Preprocessing and Data Warehousing	9 Hrs.
Data Preprocessing: Data Cleaning - Data Integration - Data Transformation - Data Reduction - ETL Process - Data Warehousing: Data Warehouse Concepts - Data Warehouse Architecture - Star Schema - Snowflake Schema - Data Cube Technology - Data Cubes - OLAP and OLTP - Metadata Management.	

UNIT III: Data Mining and Prediction Techniques	9 Hrs.
Data Mining Methodologies - Model Building and Predictive Analytics - Association Rule Mining - Apriori Algorithm - FP-Growth Algorithm - Classification - Decision Trees - Naïve Bayes - k-NN	

- Clustering - K-Means - Hierarchical Clustering - Performance Evaluation: RMSE, MAD, MAE, MAPE - Confusion Matrix.

UNIT IV: Predictive Analytics and Business Intelligence	9 Hrs.
Predictive Analytics: Regression Analysis - Linear and Multiple Regression - Time Series Forecasting - Performance Metrics - Model Evaluation - Business Intelligence: BI Architecture - Decision Support Systems - Dashboards - Key Performance Indicators (KPIs) - Data Visualization - Visualization principles - Power BI/Tableau Overview.	

UNIT V: Business Intelligence Techniques for Decision Making	9 Hrs.
Genetic algorithms - Neural network - Fuzzy logic - Support Vector Machine - Optimization techniques: Ant Colony Optimization - Particle Swarm Optimization - Data Envelopment Analysis (DEA) - Fraud Detection - Customer Relationship Management (CRM) - Recommendation Systems - Decision Support - Business Case Studies.	

TEXT BOOKS :	
1	Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 2012.
2	Ramesh Sharda, Dursun Delen, and Efraim Turban, "Business Intelligence: A Managerial Perspective on Analytics", 3rd edition, Pearson, 2018.

REFERENCE BOOKS :	
1	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, and Vipin Kumar, "Introduction to Data Mining", 2nd edition, Pearson, 2019.
2	Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3	Galit Shmueli, Peter C. Bruce, Nitin R. Patel, and Peter Gedeck, "Data Mining for Business Analytics", 3rd Edition, Wiley, 2017.
4	Sean Luke, "Essentials of Metaheuristics", Lulu Publications, 2013.
5	W. H. Inmon, "Building the Data Warehouse", 4th edition, Wiley India pvt. Ltd., 2005.

WEB REFERENCES:	
1	https://www.ibm.com/topics/data-mining
2	https://nptel.ac.in/courses/106105174
3	https://learn.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview
4	https://www.youtube.com/watch?v=Hg8zBJ1DhLQ
5	https://www.youtube.com/watch?v=tTXyRr2jLWM

COs/POs/ PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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4	2	3	2	3	3	1	–	–	1	2	2	2	3	3	2
5	2	3	3	3	3	1	–	1	1	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation




BoS Chairman

U23AD7T22	Text and Speech Analysis	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand the fundamental concepts of Natural Language Processing (NLP), computational linguistics, and speech processing, including text preprocessing and linguistic analysis
• To apply text representation techniques, word embedding models, and deep learning approaches for text classification and other NLP tasks
• To analyze and design question answering systems, chatbots, and dialogue systems using information retrieval, knowledge-based methods, and language models
• To understand the principles and architectures of Text-to-Speech (TTS) synthesis and evaluate traditional and deep learning-based speech synthesis systems
• To explore Automatic Speech Recognition (ASR) techniques, including acoustic modeling, feature extraction, HMM/DNN-based systems, and performance evaluation metrics.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the fundamentals of Natural Language Processing and text representation techniques.
CO2:	Apply text classification techniques using word embeddings and deep learning models.
CO3:	Develop question answering systems, chatbots, and dialogue systems using NLP techniques.
CO4:	Illustrate the concepts and techniques of Text-to-Speech (TTS) synthesis.
CO5:	Demonstrate the working principles of Automatic Speech Recognition (ASR) systems and their evaluation methods.

UNIT I : Natural Language Basics	9 Hrs.
Introduction to Natural Language Processing (NLP) - Foundations of natural language - Language Syntax and Structure - Text Preprocessing and Wrangling - Text tokenization - Stemming and Lemmatization - Removing stop-words - Feature Engineering for Text representation - Bag of Words (BoW) model - N-Grams model – TF-IDF model.	

UNIT II : Text Classification	9 Hrs.
Introduction to Text Classification - Vector semantics - Word embeddings - Word2Vec model - GloVe model - FastText model - Deep Learning for NLP - overview of deep learning models - Recurrent Neural Networks (RNN) - Transformer - Transformer Architecture and mechanism - Text Summarization - Topic Modeling.	

UNIT III : Question Answering and Dialogue Systems	9 Hrs.
QA architecture - Types of QA systems and challenges - Information retrieval - IR based question answering - Knowledge-based question answering - Language Models for QA - Chatbots - Rule-based chatbots - Retrieval-based chatbots - Generative chatbots - Hybrid chatbots - Dialogue Systems - Design of dialogue systems- Evaluating dialogue systems.	

UNIT IV : Text-To-Speech Synthesis	9 Hrs.
Introduction to Text-to-Speech (TTS) - Overview: Text normalization - Letter-to-Sound Conversion - Prosody Modeling - Speech Signal Processing - Concatenative Speech Synthesis - Parametric Speech Synthesis - Deep Learning-Based TTS Systems - Evaluation of TTS Systems - Mean Opinion Score (MOS) - Subjective and Objective Evaluation.	

UNIT V : Automatic Speech Recognition	9 Hrs.
Automatic Speech Recognition (ASR) pipeline - Speech Signal Processing - Feature Extraction - Acoustic Modeling - Hidden Markov Models (HMM) - HMM-DNN Hybrid Systems - Overview of End-to-End Speech Recognition - Evaluation of ASR Systems: Word Error Rate (WER) - Character Error Rate (CER) - Sentence Error Rate (SER) - Accuracy and robustness.	

TEXT BOOKS :	
1	Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
2	Lewis Tunstall, Leandro von Werra, and Thomas Wolf, “Natural Language Processing with Transformers: Building Language Applications with Hugging Face”, O'Reilly Media, 2022.

REFERENCE BOOKS :	
1	Christopher D. Manning and Hinrich Schütze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2	Nitin Indurkha and Fred J. Damerau, “Handbook of Natural Language Processing”, 2nd Edition, Chapman & Hall/CRC, 2010.
3	Deepti Chopra and Nisheeth Joshi, “Mastering Natural Language Processing with Python”, Packt Publishing, 2016.
4	Mohamed Zakaria Kurdi, “Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax”, ISTE Press/Elsevier, 2016.
5	Jacob Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.

WEB REFERENCES:	
1	https://www.oracle.com/in/artificial-intelligence/natural-language-processing/
2	https://www.deeplearning.ai/resources/natural-language-processing/#h-six-important-natural-language-processing-nlp-models
3	https://nptel.ac.in/courses/106105158
4	https://www.simplilearn.com/natural-language-processing-training-course
5	https://www.youtube.com/watch?v=FeDQMhfJnL4

COs/POs/ PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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4	2	2	3	3	3	—	—	—	1	2	1	2	2	3	2
5	3	3	2	3	3	1	—	1	1	2	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '—' - no correlation



[Signature]

BoS Chairman

U23AD7T23	Reinforcement Learning	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

To understand the fundamental concepts, principles, and applications of Reinforcement Learning and distinguish it from other machine learning paradigms
To design sequential decision-making problems using Markov Decision Processes and solve them using Dynamic Programming techniques
To apply model-free Reinforcement Learning algorithms, including Monte Carlo and Temporal Difference learning methods, for prediction and control tasks
To analyze and implement Deep Reinforcement Learning algorithms, particularly Deep Q-Networks and their variants, for solving high-dimensional problems
To develop Reinforcement Learning solutions using function approximation, policy gradient methods, and Actor-Critic architectures for complex decision-making tasks

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Explain the fundamentals of Reinforcement Learning and agent-environment interaction.
CO2:	Apply Markov Decision Processes and Dynamic Programming to solve sequential decision-making problems.
CO3:	Implement Monte Carlo and Temporal Difference learning algorithms for prediction and control tasks.
CO4:	Analyze Deep Q-Networks and their variants for solving complex reinforcement learning problems.
CO5:	Develop reinforcement learning solutions using function approximation and policy gradient methods.

UNIT I: Introduction to Reinforcement Learning	9 Hrs.
Introduction To Reinforcement Learning - History and Evolution of Reinforcement Learning - Difference between Reinforcement Learning, Supervised Learning, and Unsupervised Learning - Elements of Reinforcement Learning - Characteristics, Scope and Limitations of RL - Agent-Environment Interaction - Multi-Armed Bandit Problem.	

UNIT II: Markov Decision Process and Dynamic Programming	9 Hrs.
Markov Decision Process: Components - Action Space - Policy - Episodes and Returns - Discount factor - The Markov Property: Importance and State representation - Markov Decision Processes - Bellman Equation - Value function - Dynamic Programming - Dynamic Programming Algorithms - Value Iteration and Policy Iteration.	

UNIT III: Monte Carlo Methods and Temporal Difference Methods	9 Hrs.
Understanding Monte Carlo Method: Monte Carlo Learning - Model-free learning - Episode-based learning - Prediction and Control - Monte Carlo Prediction: First Visit and Every Visit - Monte Carlo	

Control - Temporal Difference Learning - Bootstrapping - TD Prediction - On-Policy TD Control: SARSA algorithm - Off-Policy TD Control: Q-Learning - Comparison of Learning Algorithms: Dynamic Programming vs Monte Carlo - Monte Carlo vs Temporal Difference - SARSA vs Q-Learning.

UNIT IV: Deep Q-Networks and its Variants	9 Hrs.
Introduction to Deep Reinforcement Learning - Curse of dimensionality - Deep Q-Network (DQN) - Replay Buffer - Loss Function - Target Function - DQN Architecture - Variants of DQN: Double DQN - DQN with Prioritized Experience Replay - Dueling DQN - Deep Recurrent Q-Network (DRQN) - Performance Evaluation: Atari benchmark - Hyperparameter tuning - Sample efficiency - Training stability.	

UNIT V: Function Approximation and Policy Gradient Methods	9 Hrs.
Function Approximation - Policy Gradient Methods - Policy Gradient Intuition - Variance Reduction Methods - Actor-Critic Methods: Approximation and network - Advantage Actor-Critic Algorithms: A2C (Advantage Actor-Critic) - A3C (Asynchronous Advantage Actor-Critic) - Synchronous and Asynchronous learning - Deep Deterministic Policy Gradient (DDPG) - Trust Region and Proximal Optimization (TRPO) - Proximal Policy Optimization (PPO) - Applications.	

TEXT BOOKS:	
1	Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", Second Edition, MIT Press, 2018.
2	Maxim Lapan, "Deep Reinforcement Learning Hands-On", Packt Publishing, Third Edition, 2024.

REFERENCE BOOKS:	
1	Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 2010.
2	Laura Graesser and Wah Loon Keng, "Foundations of Deep Reinforcement Learning", Addison-Wesley Professional, 2022.
3	Alexander Zai and Brandon Brown, "Deep Reinforcement Learning in Action", Manning Publications, 2023.
4	Phil Winder, "Reinforcement Learning: Industrial Applications of Intelligent Agents", O'Reilly Media, 2020.
5	Miguel Morales, "Grokking Deep Reinforcement Learning", Manning Publications, 2020.

WEB REFERENCES:	
1	https://www.simplilearn.com/tutorials/machine-learning-tutorial/reinforcement-learning
2	https://www.youtube.com/watch?v=YUbFQIMXShY https://www.youtube.com/playlist?list=PLqYmG7hTraZDM-OYHWgPebj2MfCFzFObQ
3	https://medium.com/ai%C2%B3-theory-practice-business/reinforcement-learning-part-5-monte-carlo-and-temporal-difference-learning-889053aba07d
4	https://www.coursera.org/articles/what-is-a-markov-decision-process
5	https://nptel.ac.in/courses/106106143

COs/POs/ PSOs Mapping

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4	2	3	3	3	3	1	—	—	1	2	1	2	3	3	3
5	2	3	3	3	3	1	—	1	1	2	2	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '—' - no correlation



Asghar
BoS Chairman

U23ML7T21	AI in Healthcare	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES:

- To understand AI, ML, and deep learning concepts for medical image diagnosis and healthcare decision-making
- To apply image segmentation techniques and evaluate medical imaging models using appropriate metrics
- To develop and assess prognostic and risk prediction models for healthcare decision-making
- To analyze survival data using statistical and machine learning approaches for outcome prediction
- To evaluate treatment effects using machine learning methods for personalized healthcare applications

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand medical image diagnosis concepts and analyze disease detection models using computer vision techniques.
CO2 :	Apply image segmentation techniques and analyze MRI-based medical imaging models using appropriate performance metrics.
CO3:	Analyze prognostic models and apply statistical and machine learning techniques for healthcare risk prediction.
CO4:	Execute survival models and analyze time-to-event outcomes using statistical methods for healthcare prediction.
CO5:	Implement machine learning approaches to estimate treatment effects and support healthcare decision-making.

UNIT I: Disease Detection with Computer Vision

9 Hrs.

Medical Image Diagnosis, Eye Disease and Cancer Diagnosis, Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, Image Classification and Class Imbalance, Generating More Samples, Model Testing.

UNIT II: Image Segmentation on MRI Images

9 Hrs.

Medical Image Segmentation, MRI Data and Image Registration, Segmentation, 2D U-Net and 3D U-Net, Data augmentation and loss function for segmentation, Different Populations and Diagnostic Technology, External validation, Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion Matrix, ROC Curve and Threshold.

UNIT III: Linear Prognostic Models

9 Hrs.

Medical Prognosis, Atrial fibrillation, Liver Disease Mortality, Risk of heart disease, Evaluating Prognostic Models, Concordant Pairs, Risk Ties, Permissible Pairs, Decision trees for prognosis, fix overfitting, Different distributions, Missing Data example, Imputation.

UNIT IV: Survival Models and Time

9 Hrs.

Survival Model, Survival function, collecting time data, Estimating the survival function, Hazard Functions, Relative risk, Individual vs. baseline hazard, Survival Trees, Nelson Aalen estimator.

UNIT V - Medical Treatment Effect Estimation**9 Hrs.**

Analyze data from a randomized control trial, Average treatment effect, Conditional average treatment effect, T-Learner, S-Learner, C-for-benefit.

Total Hours: 45**TEXT BOOKS:**

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, O'Reilly Media, 2022.
2. Kevin P. Murphy, "Probabilistic Machine Learning: An Introduction", MIT Press, 2022.

REFERENCE BOOKS:

1. D. Jude Hemanth and Valentina Emilia Balas, "Artificial Intelligence Techniques for Biomedical Signal Processing", Springer.
2. Rafael A. Irizarry, "Introduction to Data Science for Medical Research", CRC Press, 2017.
3. Frank Harrell, Regression Modeling Strategies, Springer, 2015.

WEB REFERENCES:

1. <https://www.tensorflow.org/tutorials/images>
2. <https://landscape.pytorch.org/guide>
3. <https://www.cancerimagingarchive.net/browse-collections/>
4. <https://www.nlm.nih.gov/>

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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4	3	3	2	3	3	-	-	1	1	1	2	3	3	3	3
5	3	3	3	3	3	1	-	2	2	2	3	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U23ML7T22	Machine Learning for Cyber Security	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To understand machine learning security fundamentals, threat models, attack surfaces, and trustworthy AI principles through real-world case studies
• To understand adversarial attacks, threat models, and their evaluation in AI systems through real-world case studies
• To understand data privacy challenges and apply privacy-preserving techniques for secure AI systems
• To understand and apply robustness techniques, explainable AI, and secure deployment practices for building trustworthy machine learning models
• To understand secure AI systems including LLM security, governance, and zero-trust architectures for resilient machine learning

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	Understand secure machine learning fundamentals, threat models, CIA triad, and trustworthy AI principles.
CO2 :	Analyze adversarial attacks and their impact on AI systems.
CO3:	Understand privacy-preserving techniques and regulations for secure AI.
CO4:	Build robust and explainable AI systems with secure deployment practices.
CO5:	Develop secure AI solutions for emerging applications and architectures.

UNIT I: Introduction To Secure Machine Learning	9 Hrs.
Fundamentals of Machine Learning Security, Security Challenges in AI Systems, Threat Models for Machine Learning, CIA Triad (Confidentiality, Integrity, Availability) in ML Attack Surface of ML Pipelines, Security Risks in Data Collection, Training, and Deployment, Trustworthy AI Principles, Case Studies of AI Security Breaches.	

UNIT II: Adversarial Machine Learning	9 Hrs.
Introduction to Adversarial Attacks, Adversarial Examples and Threat Modeling, Evasion Attacks, Poisoning Attacks, Backdoor and Trojan Attacks, Model Inversion Attacks, Membership Inference Attacks, Adversarial Attack Generation Techniques, Security Evaluation Metrics, Real-world Applications and Case Studies.	

UNIT III: Privacy-Preserving Machine Learning	9 Hrs.
Data Privacy Challenges in AI, Privacy Regulations (GDPR, HIPAA, DPDP Act) Differential Privacy, Federated Learning Fundamentals, Secure Aggregation Techniques Homomorphic Encryption, Secure Multi-Party Computation (SMPC), Privacy-Preserving Data Sharing, Privacy Risks in Generative AI, Privacy Auditing of ML Systems.	

UNIT IV: Robust And Explainable AI Systems	9 Hrs.
Robustness in Machine Learning Models, Adversarial Training, Defensive Distillation, Model Verification and Validation, Explainable AI (XAI) Fundamentals, Secure Model Deployment Practices.	

UNIT V – Secure AI Applications And Emerging Trends	9 Hrs.
Security in Large Language Models (LLMs), Secure Generative AI, AI for Cybersecurity, AI Security in Healthcare, AI Security in Finance and Banking, Edge AI Security, Blockchain for AI Security, Zero-Trust AI Architectures, AI Governance and Risk Management, Future Trends in Secure Machine Learning.	

Total Hours: 45

TEXT BOOKS:	
1.	Clarence Chio and David Freeman, “Machine Learning and Security: Protecting Systems with Data and Algorithms”, O'Reilly Media, 2018.
2.	Nicolas Papernot, Patrick McDaniel, Arunesh Sinha, Michael Wellman, and Zhiqiang Lin, “Adversarial Machine Learning”, Springer, 2019.
3.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

REFERENCE BOOKS:	
1	Andrew Burt and Edward W. Felten, “Privacy Engineering for Machine Learning Systems”, O'Reilly Media.
2	Ninghui Li, Min Lyu, Dong Su, and Weining Yang, “Differential Privacy: From Theory to Practice”, Morgan & Claypool Publishers.
3.	Yevgeniy Vorobeychik and Murat Kantarcioglu, “Adversarial Machine Learning”, Morgan & Claypool Publishers, 2018.
4.	Nitin H. Vaidya, “Distributed Machine Learning and Federated Learning Systems”, Springer, 2021.

WEB REFERENCES:	
1.	https://owasp.org/www-project-machine-learning-security-top-10/
2.	https://atlas.mitre.org/
3.	https://www.tensorflow.org/responsible_ai/privacy/guide
4.	https://www.tensorflow.org/federated
5.	https://www.ibm.com/think/topics/trustworthy-ai

COs/POs/PSOs Mapping:															
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4	3	3	3	3	3	2	–	2	1	1	–	2	3	3	3
5	3	3	3	3	3	3	–	3	1	1	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation




BoS Chairman

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course Title
1.	U23MB7T05	Quality Management for Engineers
2.	U23CM7T01	Intellectual Property Rights and Business Ethics
3.	U23EC7E08	Remote Sensing



BoS Chairman

U23MB7T05	Quality Management For Engineers	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To introduce quality evolution and the contributions of key quality gurus.
• To understand TQM principles in product design and risk analysis techniques.
• To explore modern process improvement tools like Six Sigma, TPM, and Lean.
• To apply quality improvement tools for continuous improvement in processes.
• To gain knowledge of quality management standards and certification systems.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain the evolution of TQM and the philosophies of major quality gurus.
CO2 :	Apply quality tools in product design and perform design risk analysis.
CO3 :	Use modern techniques like Six Sigma and Lean for process improvement.
CO4 :	Implement continuous improvement tools such as QFD, Kaizen, and SPC.
CO5 :	Describe and compare international quality standards and certifications.

UNIT I : Quality Gurus And Tqm Kitemarks	9 Hrs.
Evolution of Quality (Inspection → Quality Control → QA → TQM) - Dimensions of Quality - Cost of Quality (Prevention, Appraisal, Failure Costs) - Customer Satisfaction and Customer Focus Quality Guru's – Edward Deming – Joseph Juran – Philip Crosby – Genichi Taguchi – Walter Shewart – Criteria for Deming's Prize - Malcolm Baldrige National Quality Award (MBNQA) - EFQM Excellence Model.	

UNIT II : Product Design And Analysis	9 Hrs.
Product Life Cycle and Quality Considerations - Design Concepts and TQM – Design Assurance – Design Validation – Quality by Design (QbD) - Design for Manufacturability (DFM) - Design for Assembly (DFA) - Failure Mode Effect Analysis – Fault Tree Analysis- Design for Robustness – Concurrent Engineering - Reliability Engineering Basics - Value Analysis.	

UNIT III : Process Improvement And Modern Production Management Tools	9 Hrs.
Six Sigma Approach – Total Productive Maintenance – Just-In- Time – DMAIC Methodology - 5 Lean Principles - Lean Manufacturing Paradigms - Value Stream Mapping (VSM) - Theory of Constraints (TOC) - Overall Equipment Effectiveness (OEE) - Industry 4.0 and Smart Manufacturing Overview.	

UNIT IV : Quality Improvement Tools And Continuous Improvement	9 Hrs.
Old Quality Tools – New Quality Tools – Quality Function Deployment – Kaizen – 5S – Poka-Yoke- Root Cause Analysis- Statistical Process Control(SPC) – Benchmarking - Quality Circles.	

UNIT V – Quality Management Systems	9 Hrs.
Quality Management Systems – Introduction to ISO9000 – TS16949:2002 and EMS14001 certifications - ISO 9001:2015 Principles - ISO 45001 (Occupational Health & Safety) - Integrated Management Systems (IMS) - Internal Quality Audits - Documentation and Record Control - Business Excellence Models and Continuous Improvement Frameworks	

Total Hours: 45

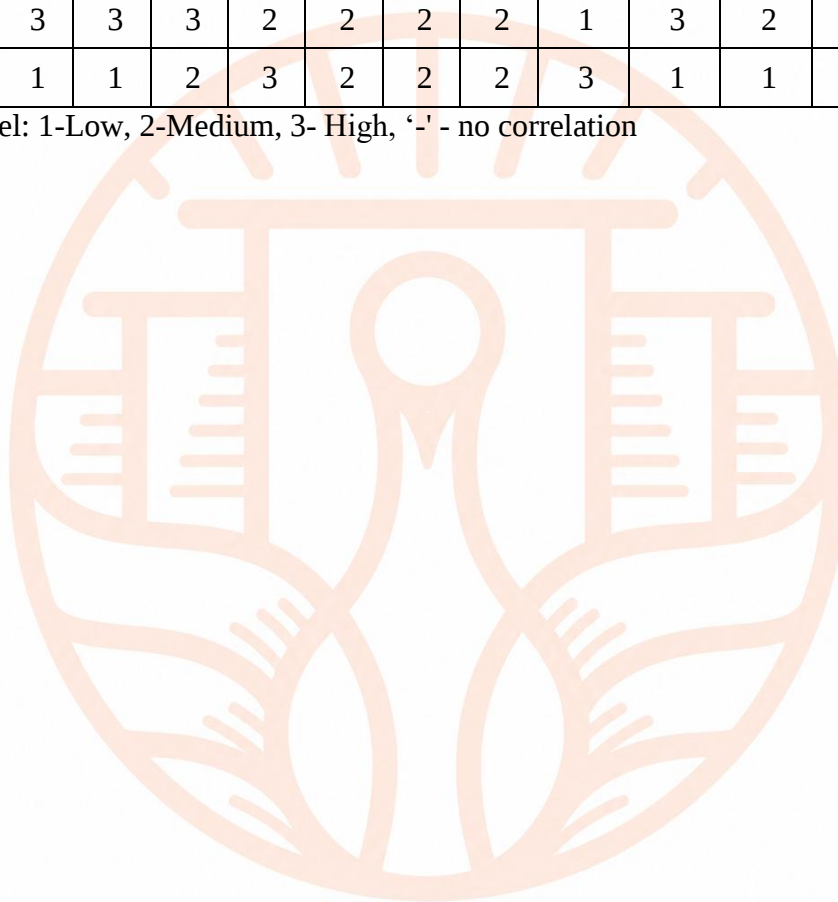
TEXT BOOKS :	
1.	Sharma, S., Total Engineering Quality Management, 1st Edition, Macmillan India Limited.
2.	Charantimath, P. M., Total Quality Management, 3rd Edition, Pearson Education, 2017.
3.	Besterfield, D. H., Besterfield-Michna, C., Besterfield, G. H., & Besterfield-Sacre, M., Total Quality Management, 3rd Edition, Pearson Education, 2011.
4.	Oakland, J. S., Total Quality Management and Operational Excellence: Text with Cases, 5th Edition, Routledge, 2014.
5.	Goetsch, D. L., & Davis, S. B., Quality Management for Organizational Excellence: Introduction to Total Quality, 9th Edition, Pearson, 2021.

REFERENCE BOOKS :	
1.	Evans, J. R., & Lindsay, W. M., Managing for Quality and Performance Excellence, 11th Edition, Cengage Learning, 2020.
2.	Gitlow, H. S., Oppenheim, A. J., Oppenheim, R., & Levine, D. M., Quality Management: Tools and Methods for Improvement, 3rd Edition, McGraw-Hill Education, 2005.
3.	Mitra, A., Fundamentals of Quality Control and Improvement, 4th Edition, Wiley India, 2016.
4.	Juran, J. M., & De Feo, J. A., Juran's Quality Handbook: The Complete Guide to Performance Excellence, 7th Edition, McGraw-Hill Education, 2017.
5.	Pyzdek, T., & Keller, P. A., The Six Sigma Handbook, 5th Edition, McGraw-Hill Education, 2021.

WEB REFERENCES :	
1.	https://asq.org
2.	https://www.iso.org
3.	https://www.nist.gov/baldrige
4.	https://www.lean.org
5.	https://www.isixsigma.com

COs/POs/PSOs Mapping :															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	–	–	1	2	2	–	1	1	–	–	1	–	2
2	2	3	3	2	2	–	1	1	–	–	1	2	2	2	1
3	2	3	3	2	3	1	2	2	1	1	2	2	3	3	1
4	2	3	3	3	3	2	2	2	2	1	3	2	3	3	2
5	2	2	1	1	2	3	2	2	2	3	1	1	2	1	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation



BoS Chairman

U23CM7T01	Intellectual Property Rights & Business Ethics	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

To understand the fundamentals and significance of Intellectual Property Rights (IPR) in business and innovation.
To familiarize students with various forms of intellectual property and their legal protection mechanisms.
To examine national and international legal frameworks governing intellectual property rights.
To develop awareness of ethical principles, values, and responsibilities in business decision-making.
To analyze ethical issues, corporate governance practices, and social responsibility in contemporary business organizations.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Explain the concepts, significance, and categories of Intellectual Property Rights.
CO2 :	Identify and differentiate patents, copyrights, trademarks, geographical indications, industrial designs, and trade secrets.
CO3 :	Examine national and international legal frameworks governing IPR and their business implications.
CO4 :	Analyze ethical theories and principles applicable to business decision-making.
CO5 :	Evaluate ethical issues, corporate governance practices, and corporate social responsibility initiatives.

UNIT I : Introduction To Intellectual Property Rights	12 Hrs.
Meaning and Nature of Intellectual Property - Evolution and Importance of IPR - Role of IPR in Innovation and Economic Development - Intellectual Property as a Business Asset - Need for Protection of Intellectual Property - Overview of Intellectual Property Laws in India - World Intellectual Property Rights Scenario - WIPO, WTO and TRIPS Agreement.	

UNIT II : Product Design And Analysis	12 Hrs.
Patents: Meaning, Features, Patentability Criteria - Copyrights: Scope and Protection - Trademarks and Service Marks - Industrial Designs - Geographical Indications - Trade Secrets and Confidential Information - Plant Variety Protection - Infringement and Remedies.	

UNIT III : Process Improvement And Modern Production Management Tools	12 Hrs.
Registration Procedures for Patents, Copyrights and Trademarks - Licensing and Assignment of Intellectual Property - Commercialization of Intellectual Property - Technology Transfer - Intellectual Property Valuation - Digital Intellectual Property and Cyber Issues - IPR Enforcement Mechanisms - International Treaties and Conventions.	

UNIT IV : Quality Improvement Tools And Continuous Improvement	12 Hrs.
Meaning, Nature and Scope of Business Ethics - Ethics, Morality and Values - Ethical Theories and Models - Ethical Decision-Making Process - Corporate Governance: Concepts and Principles - Stakeholder Theory - Corporate Codes of Conduct - Transparency, Accountability and Ethical Leadership.	

UNIT V – Quality Management Systems	12 Hrs.
Corporate Social Responsibility (CSR) - CSR under Companies Act, 2013 - Environmental Ethics and Sustainability - Consumer Protection and Ethical Marketing - Ethical Issues in E-Commerce and Digital Business - Whistleblowing and Ethical Dilemmas - Business Ethics in the Global Environment - Case Studies on IPR and Business Ethics.	

Total Hours: 45

TEXT BOOKS :	
1.	B.L. Wadhera (2023), Law Relating to Intellectual Property, Universal Law Publishing, New Delhi.
2.	V.K. Ahuja (2024), Intellectual Property Rights in India, LexisNexis, New Delhi.
3.	C.S.V. Murthy (2023), Business Ethics and Corporate Governance, Himalaya Publishing House, Mumbai.
4.	A.C. Fernando (2024), Business Ethics and Corporate Governance, Pearson Education, New Delhi.

REFERENCE BOOKS :	
1.	P. Narayanan (2023), Intellectual Property Law, Eastern Law House.
2.	David Bainbridge (2023), Intellectual Property, Pearson Education.
3.	Richard T. DE George (2023), Business Ethics, McGraw-Hill Education.
4.	Manuel G. Velasquez (2024), Business Ethics: Concepts and Cases, Pearson.
5.	WIPO (2023), WIPO Intellectual Property Handbook.
6.	S.S. Khanka (2023), Business Ethics and Corporate Governance, S. Chand Publishing.

WEB REFERENCES :	
1.	https://www.coursera.org/search?query=intellectual%20property
2.	https://www.coursera.org/search?query=business%20ethics
3.	https://www.edx.org/search?q=intellectual+property
4.	https://onlinecourses.nptel.ac.in/
5.	https://www.edx.org/search?q=business+ethics

COs/POs/PSOs Mapping :															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	–	–	–	2	1	2	–	1	–	2	–	–	1
2	2	3	–	1	–	2	–	2	–	1	–	1	1	1	2
3	2	3	1	2	1	3	–	2	–	2	1	2	2	2	2
4	–	2	2	–	–	3	2	3	1	2	1	2	–	1	3
5	–	2	2	1	–	3	3	3	2	2	2	3	1	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '–' - no correlation



BoS Chairman

U23EC7E08	Remote Sensing	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To discuss the fundamentals of remote sensing and electromagnetic radiation
• To explain various remote sensing platforms, sensors, and imaging systems
• To analyze image interpretation and digital image processing techniques
• To discuss microwave, thermal, and hyperspectral remote sensing systems
• To explain applications of remote sensing in agriculture, environment, disaster management, and urban planning

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1:	To demonstrate the principles of remote sensing and electromagnetic radiation interaction with atmosphere and earth surface.
CO2:	To examine various remote sensing platforms, sensors, and data acquisition systems.
CO3:	To experiment with image interpretation and digital image processing techniques.
CO4:	To analyze microwave, thermal, and hyperspectral remote sensing systems and their applications.
CO5:	To determine the applications of remote sensing in resource management, environment monitoring, and disaster management.

UNIT I: Introduction to Remote Sensing	9 Hrs.
Introduction to Remote Sensing – History and development of remote sensing – Components of Remote Sensing system – Electromagnetic Radiation (EMR) – Electromagnetic Spectrum – Interaction of EMR with atmosphere – Atmospheric windows – Interaction with earth surface materials – Spectral signatures – Resolution concepts: Spatial, Spectral, Radiometric and Temporal resolution – Principles of image acquisition.	

UNIT II: Remote Sensing Platforms and Sensors	9 Hrs.
Types of platforms – Ground based, Airborne and Space borne platforms – Satellite orbits – Remote sensing satellites – Passive and Active sensors – Optical sensors – Thermal sensors – Microwave sensors – Multispectral and Hyperspectral sensors – Scanning systems – Sensor characteristics – Data products and formats – Indian Remote Sensing Satellites (IRS) – LANDSAT, SPOT, NOAA and Sentinel satellites.	

UNIT III: Image Interpretation and Digital Image Processing	9 Hrs.
Visual image interpretation – Elements of image interpretation – Digital image processing fundamentals – Image enhancement techniques – Histogram equalization – Spatial filtering – Image classification – Supervised and unsupervised classification – Feature extraction – Change detection – Accuracy assessment – Remote sensing software overview.	

UNIT IV: Microwave and Thermal Remote Sensing	9 Hrs.
Principles of Microwave Remote Sensing – RADAR systems – Synthetic Aperture Radar (SAR) – Scatterometers and Altimeters – Thermal infrared remote sensing – Thermal properties of materials – Thermal imaging systems – Hyperspectral remote sensing – LiDAR principles – Applications of microwave and thermal remote sensing in terrain analysis and environmental studies.	

UNIT V – Applications of Remote Sensing	9 Hrs.
Applications in agriculture – Forestry and vegetation analysis – Water resources management – Urban and regional planning – Geology and mineral exploration – Ocean and coastal studies – Weather forecasting and climate studies – Disaster management – Environmental monitoring – GIS and Remote Sensing integration – Emerging trends in remote sensing and geospatial technologies.	

Total Hours: 45

TEXT BOOKS:	
1.	Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, “Remote Sensing and Image Interpretation”, Wiley India, 6th Edition, 2015.
2.	George Joseph and C. Jeganathan, “Fundamentals of Remote Sensing”, Universities Press, 3rd Edition, 2018.

REFERENCE BOOKS:	
1	Floyd F. Sabins, “Remote Sensing Principles and Interpretation”, Waveland Press, 3rd Edition, 2007.
2	James B. Campbell and Randolph H. Wynne, “Introduction to Remote Sensing”, Guilford Press, 5th Edition, 2011.
3.	Paul R. Wolf, Bon A. Dewitt and Benjamin E. Wilkinson, “Elements of Photogrammetry with Applications in GIS”, McGraw Hill Education, 4th Edition, 2014.

WEB REFERENCES:	
1.	https://earthobservatory.nasa.gov/
2.	https://earthexplorer.usgs.gov/
3.	https://earth.esa.int/

COs/POs/PSOs Mapping:															
COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	-	-	-	-	-	-	-	1	2	1	2
2	3	2	2	-	1	-	-	-	-	-	-	1	3	2	2
3	3	2	3	-	2	-	-	-	-	-	-	1	3	3	2
4	3	2	2	-	2	1	-	-	-	-	-	1	3	3	2
5	3	2	1	-	3	2	1	1	-	1	-	2	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation



BoS Chairman



U23CE7W01	Project Phase- I	L	T	P	C
		0	0	12	6

COURSE OBJECTIVES:

- To assimilate the theoretical knowledge gained in the courses for real-life practical applications in order to have effective learning and skill development, mainly, from the point of view of employability in industries.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	To Practice how to work together in a team. An essential skill in the industry.
CO2 :	To apply the theoretical knowledge learned from other courses, which is required by industry.
CO3 :	To learn how to make presentations in a team. A soft skill needed in research and industry.
CO4 :	Peer learning from the evaluation of other teams' work. A skill that is essential when one is in a workforce.
CO5 :	To examine different hardware/software components and their working.

GUIDELINE FOR PROJECT:

1.	Participants will be divided into teams of two or three members within the first week of the starting of the course by the course coordinators depending on the number of participants registered in the course.
2.	The teams will have a team coordinator or leader, which will be identified by the coordinators of the course.
3.	The projects could be of the following types: a. Literature search (LS) type: Studying about an aspect of AI, Data science, Machine learning and Robotics, say, vision, robot kinematics, dynamics, controls, etc. b. Application Development: Apply the existing algorithm to solve real-world problems. For example, developing software/hardware applications using machine learning libraries/frameworks. c. Algorithm development (AD) type: Analyse, say, a robot kinematics using RoboAnalyzer or PythonNimpy / Octave / Freemat / Scilab / Matlab software or write an algorithm using any programming language (Python, etc.). For example, writing forward kinematics of a robot or image processing in Vision. d. Design/synthesis (DS) type: Proposing a new type of system/device for performing certain task.
4.	The teams will be asked to contact their team members within a week and decide their topic with two weeks, i.e., within first 3 weeks of the starting of the course.

- | | |
|----|--|
| 5. | Students MUST spend minimum of twenty-five hours to discuss their progress together, study together or individually, write programmes, fabricate circuits, etc. |
| 6. | During the five-lecture hour the coordinators will explain how to do literature survey, how to find the sources of hardware, which software to use for a particular purpose, what are the opensource licensing models available, how to maintain an opensource software etc. |
| 7. | At the end of the course duration, each team will submit a presentation of minimum 5 slides in.pdf file, a video of one min to showcase their project and a printed report of minimum 10 pages. |

GUIDELINE FOR ASSESSMENT OF PROJECT PRACTICAL / ORAL EXAMINATION:

- | | |
|----|---|
| 1. | At the end of the course duration, each team will submit a presentation of minimum 5 slides in.pdf file, a video of one min to showcase their project and a printed report of minimum 10 pages. |
|----|---|

PROJECT SHALL BE ASSESSED BASED ON FOLLOWING POINTS:

- | | |
|----|--|
| 1. | Peer Evaluations (20%): Presentations in .pdf will be evaluated by two other teams and grade them out of 10 marks. |
| 2. | Expert evaluation (80%): Coordinators will take a presentation of 3 mins. plus, Q&A in a common session to give marks out of 80. |



BoS Chairman

U23UM7P31	Takshashila Innovative Learning -VII	L	T	P	C	Total
		0	0	2	1	30

This course enables students to apply the knowledge and skills acquired through online learning platforms by undertaking domain-specific certification courses, guided mini projects, internships, and portfolio development. Students will strengthen their technical competencies in their respective disciplines through hands-on learning while enhancing their professional profile with industry-recognized credentials and practical experience.

COURSE OBJECTIVES:

• To encourage students to complete advanced domain-specific online certification courses.
• To apply theoretical knowledge through guided projects and practical assignments.
• To develop problem-solving, analytical, and professional skills relevant to industry.
• To build a digital portfolio showcasing certifications, projects, and technical competencies.
• To prepare students for internships, placements, and higher studies through experiential learning.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Select and complete an advanced online certification relevant to their discipline.
CO2 :	Apply technical knowledge to solve real-world problems through guided projects or internships.
CO3 :	Demonstrate practical competency using modern tools and technologies in their domain.
CO4 :	Develop and present a professional digital portfolio highlighting certifications and project outcomes.
CO5 :	Enhance employability through industry-oriented learning, documentation, and professional communication.

COURSE STRUCTURE:

• Online domain-specific certification through recognized platforms.
• Guided project/internship activities and mentor interactions.
• Weekly progress review and documentation.
• Portfolio development and technical presentation.
• Final assessment based on certification, project completion, and portfolio

MODULE I : Industry Readiness & Project Planning	6 Hrs.
Introduction to Takshashila Innovative Learning (TIL) – Industry expectations and professional ethics – Identification of real-world engineering problems – Design thinking and innovation – Internship orientation – Team formation – Problem definition – Project planning, requirement analysis, and mentor approval.	

MODULE II : Internship & Project Development**6 Hrs.**

Internship in industry, research organizations, startups, or MSMEs – Project initiation – Literature survey – System design and workflow – Development environment setup – GitHub repository creation – UNIT planning – Progress monitoring and activity log maintenance.

MODULE III : Implementation, Testing & Documentation**6 Hrs.**

Implementation of project UNITs – Testing, debugging, and validation – Performance improvement – Technical documentation – Internship progress review – Project report preparation – Mentor feedback and continuous improvement.

MODULE IV : Research, Publication & Intellectual Property**6 Hrs.**

Research methodology – Literature review – Technical paper writing – Research paper submission/publication in conferences or journals – Plagiarism and citation practices – Introduction to Intellectual Property Rights (IPR), patents, copyrights, and innovation.

MODULE V - Professional Development & Final Evaluation**6 Hrs.**

Preparation of technical presentations – GitHub portfolio development – Resume and LinkedIn profile enhancement – Project demonstration – Internship presentation – Viva voce – Submission of internship report, project report, and research paper – Career readiness and professional development.

**BoS Chairman**

U23UM7P32	Critical Thinking	L	T	P	C	Total
		0	0	2	1	30

COURSE OBJECTIVES:

• To develop critical thinking skills for engineering problem solving
• To apply scientific reasoning for evidence-based engineering decisions
• To recognize cognitive biases affecting engineering judgments
• To promote ethical reasoning and professional engineering responsibility
• To analyze engineering case studies for informed decision-making

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1	Develop principles of critical thinking in engineering.
CO2	Apply scientific and quantitative reasoning to engineering problems.
CO3	Identify cognitive biases influencing engineering decisions.
CO4	Evaluate engineering decisions using ethical principles.
CO5	Analyze engineering case studies for professional learning.

UNIT I : Foundations of Critical Thinking	6 Hrs.
Critical thinking – Definition, importance, and myths – Characteristics of a critical thinker –Thinking vs. feeling: subjective vs. objective reasoning – Critical thinking in the engineering context	

UNIT II : Scientific and Quantitative Reasoning	6 Hrs.
The scientific method and hypothesis testing – Correlation vs. causation – Understanding statistics: mean, variance, probability, confidence intervals – Data interpretation and misrepresentation	

UNIT III : Cognitive Biases and Heuristics	6 Hrs.
Types of biases: confirmation bias, anchoring, availability heuristic, sunk cost fallacy – Heuristics: when they help and when they mislead – Groupthink and its impact on engineering teams – Strategies to de-bias individual and team decisions – Case studies: engineering failures caused by cognitive biases	

UNIT IV : Ethical Reasoning In Engineering	6 Hrs.
Engineering ethics and codes of conduct – Ethical frameworks: consequentialism, deontology, virtue ethics – Moral reasoning under uncertainty – Whistleblowing – Professional responsibility and Public safety	

UNIT V: Critical Thinking	6 Hrs.
Case studies: Bhopal gas tragedy, Boeing 737 MAX, Theranostics	

. Total Hours: 30

TEXT BOOKS :

1.	M. Browne, Stuart Keeley, "Asking the Right Questions: A Guide to Critical Thinking" Pearson Publication, Global 11 th Edition., 2014.
2.	Rolf Dobelli, "The Art of Thinking Clearly: Better Thinking, Better Decisions", Sceptre Publication, 2014.
3.	Daniel Kahneman, "Thinking, Fast and Slow" Jain Book Depo Publication, July 2020.
4.	Charles B. Fleddermann, "Engineering Ethics", Pearson College Div Publication, 4 th Edition, 2011.

REFERENCE BOOKS :

1.	Ben Goldacre, "Bad Science", Harper Perennial Publisher, 2009.
2.	Don Norman, "THE DESIGN OF EVERYDAY THINGS", Basic Books, 2013.

WEB REFERENCES :

1.	https://nptel.ac.in/courses/109105396
2.	https://onlinecourses.swayam2.ac.in/e-learning/preview/aic19_ma06
3.	https://www.youtube.com/watch?v=0WemMWbosVs
4.	https://www.youtube.com/watch?v=2SwCinc6JEY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	-	-	-	-	-	1	-	1	-	2	2	-	-
2	3	3	-	2	-	-	-	-	-	-	-	2	3	1	-
3	2	3	-	-	-	-	-	2	3	2	-	2	2	2	-
4	3	2	-	-	-	3	2	3	2	2	-	2	-	-	1
5	2	3	-	2	-	2	1	3	2	2	-	2	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High, '-' - no correlation


BoS Chairman

U23UM7P33	Green Credit -VII	L	T	P	C	Total
		0	0	2	1	30

COURSE OBJECTIVES:

• To introduce students to aromatic plants and their importance
• To explain the cultivation methods of aromatic plants.

COURSE OUTCOMES:

After completion of the course, the students will be able to

CO1 :	Identify and classify common aromatic plants.
CO2 :	Understand cultivation and propagation methods of aromatic plants.

Module -1 Introduction

- Definition and scopes
- Importance of Aromatic Plants
- Classification of Aromatic Plants
- Common Aromatic Plants

Module-2 Management Practices

- Soil management
- Pest management
- Plant maintenance
- Water management

Questions

1. Classify aromatic plants with suitable examples.
2. Explain the cultivation practices of aromatic plants.



BoS Chairman