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TAKSHASHILA UNIVERSITY

(Tamil Nadu State Private University)

ONGUR, TINDIVANAM TK, VILLUPURAM DT

FACULTY OF ENGINEERING AND TECHNOLOGY

SCHOOL OF COMPUTATIONAL ENGINEERING

Department of Artificial Intelligence and Data Science

with IBM

REGULATION – R23

CURRICULUM & SYLLABI

VII Semester

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 Artificial Intelligence and Data Science by fostering transformative education, interdisciplinary research and innovation to develop intelligent, ethical, and sustainable solutions that address global challenges and contribute to societal progress**.**

MISSION:

M1: Academic Excellence	Deliver a contemporary, outcome-based curriculum that equips students with strong foundations in Artificial Intelligence, Data Science and computational thinking to solve complex real-world problems.
M2: Research and Innovation	Promote interdisciplinary research, innovation, and the adoption of emerging AI and data-driven technologies to develop impactful solutions for industrial and societal needs.
M3: Industry Readiness and Entrepreneurship	Strengthen employability and entrepreneurial capabilities through industry collaborations, experiential learning, internships, professional certifications and start-up incubation.
M4: Ethics and Lifelong Learning	In still ethical values, responsible AI practices, professional integrity, and a commitment to lifelong learning to develop socially responsible leaders capable of driving sustainable technological advancement.

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 continuous learning in the face of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Competitive Platform

To create a competitive platform for solving critical problems in a wide variety of fields.

PEO2: Exploration

Enthusiastic participation in learning, understanding, designing and applying new innovative research ideas as the field evolves.

PEO3: Career

Applying cutting-edge technology that improves knowledge and to commit students for life-long learning to reach the leading positions in the career.

PEO4: Professional Values

Simulate the graduates to hold the responsibilities in the context of technology, ethics, society and humanity.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: AI and Data Analytics Competency

Apply the principles of Artificial Intelligence and Data Science to develop intelligent, data-driven solutions for complex real-world problems.

PSO2: Research and Innovation

Design and implement AI-based and data-centric solutions using modern tools, emerging technologies and research methodologies to address industrial and societal challenges.

PSO3: Professional Competence

Demonstrate professional ethics, entrepreneurial mind-set and lifelong learning to excel in careers, higher education, research, and innovation in Artificial Intelligence and Data Science.

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

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FACULTY OF ENGINEERING AND TECHNOLOGY
B.TECH. IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE WITH IBM
(REGULATION – R23)
SEMESTER – VII

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Hrs.	Max. Marks								
				L	T	P			CAT Theory (Best of two)	ASS	MCQ	ATT	SEM	P	CAM	ESM	Total
1	U23AD7T01	Edge Analytics	PC	3	0	0	3	45	20	5	5	5	5	-	40	60	100
2	U23CE7T01	Wireless Sensor Networks	PC	3	0	0	3	45	20	5	5	5	5	-	40	60	100
3	U23AD7T61	Artificial Intelligence Analysts	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	U23**7T**	Open Elective – V	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	-	-	-	10	10	30	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
T – Tutorial
P – Practical
PW – Project Work

ASS – Assignment
ATT – Attendance
CAM – Continuous Assessment Marks

SEM – Seminar
CAT – Continuous Assessment Test
ESM – End Semester Exam Marks

BoS Chairman

U23AD7T01	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.
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.	

Total Hours: 45

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.	OpenFog Consortium Architecture Working Group, OpenFog Reference Architecture for Fog Computing, OpenFog Consortium
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 (Eds.), Fog and Edge Computing: Principles and Paradigms, John Wiley & Sons, 2019.

5.	D. Jude Hemanth and Valentina Emilia Balas (Eds.), 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)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	–	–	2	1	1	–	–	–	–	1	3	1	1
2	3	3	2	2	3	–	–	–	–	–	–	1	3	2	2
3	2	3	3	3	3	–	–	–	1	1	–	2	3	3	2
4	2	2	3	2	3	1	–	1	1	1	1	2	3	2	3
5	2	3	3	3	3	3	2	2	1	1	–	2	3	3	3

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

BoS Chairman

U23CE7T01	Wireless Sensor Networks	L	T	P	C	Total
		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: 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.	

Total Hours: 45

TEXT BOOKS:	
1.	Hossam Mahmoud Ahmad Fahmy, Concepts, Applications, Experimentation and Analysis of Wireless Sensor Network, Springer, 2023.
2.	Samayveer Singh et al., 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**
1	3	2	–	–	2	–	–	–	–	–	–	1	3	1	1
2	3	3	2	2	2	–	–	–	–	–	–	1	3	2	2
3	2	3	3	2	3	–	2	–	–	–	–	1	3	2	2
4	2	3	3	3	3	–	2	–	1	1	–	2	3	3	2
5	2	3	2	2	2	2	1	3	–	1	–	2	2	3	2

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

BoS Chairman

U23AD7T61	Artificial Intelligence Analysts	L	T	P	C	Total
		3	0	0	3	45

COURSE OBJECTIVES:

• To Understand AI Foundations – Gain knowledge of artificial intelligence concepts, types, applications, and industry trends
• To Explore IBM Watson – Learn IBM Watson services, Watson Studio, and their applications in business, science, and analytics
• To Apply Machine Learning – Implement machine learning algorithms, AutoAI experiments, and regression models using Watson ML
• To Develop NLP and Conversational AI – Understand natural language processing concepts, evaluation metrics, and build chatbots with Watson Assistant
• To Implement Computer Vision Solutions – Apply deep learning models for image recognition and design intelligent solutions integrating Watson services.

COURSE OUTCOMES:

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

CO1:	Demonstrate AI knowledge – Explain AI foundations, advancements, and IBM Watson's role in industry applications.
CO2:	Utilize Watson Studio – Apply IBM Watson Studio for building, training, and deploying machine learning models.
CO3:	Implement AutoAI and ML models – Create AutoAI experiments, regression models, and deploy them using Watson ML.
CO4:	Build NLP and Chatbots – Apply NLP techniques and develop conversational AI solutions using Watson Assistant and Knowledge Studio.
CO5:	Design Intelligent Solutions – Integrate computer vision, NLP, and Watson services to deliver innovative AI-driven business and technical solutions.

UNIT I: AI FOUNDATION	**9 Hrs.**
Artificial Intelligence Overview - AI overview trends advancements - Types of AI and its applications - Business Analytics - AI Research Focus (AI Videos) - Machine learning videos- Artificial Intelligence Foundations - Setting up your hands-on environment - IBM Watson Overview - Introduction to Watson - IBM Watson applied to industry business and science - IBM	

Watson Use-Cases - Evolution from DeepQA to Watson Services - Watson Services Overview Part-I - Watson Services Overview Part-II.

UNIT II: BASICS OF MACHINE LEARNING	**9 Hrs.**
Machine Learning - Introduction to Machine Learning - Exercise - Applying Machine Learning Algorithms-IBM Watson & IBM Watson Studio - Introduction to IBM Watson - Exploring IBM Watson services - Introduction to IBM Watson Studio - Exercise - Getting Started with IBM Watson Studio (WML).	

UNIT III: WATSON ML & AUTOAI	**9 Hrs.**
IBM Watson Machine Learning and AutoAI - Introduction to IBM Watson Machine Learning and AutoAI - Exercise - Getting started with IBM Watson Machine Learning – Exercise: Creating an AutoAI experiment from marketing data – Exercise: Building and deploying a regression analysis model with (WML)-Natural Language Processing (NLP) - Introduction to Natural Language Processing - NLP Concepts and components - NLP Evaluation Metrics - NLP and IBM Watson - Exercise: Ingesting converting enriching and querying data.	

UNIT IV: CONVERSATIONAL AI	**9 Hrs.**
IBM Watson Knowledge Studio - Introduction to IBM Watson Knowledge Studio - Exercise: Creating a machine learning model with IBM Watson Knowledge Studio. Chatbots & Watson Assistant - Introduction to Chatbots - Introduction to IBM Watson Assistant - Exercise: Getting started with IBM Watson Assistant - Exercise: Help Desk Chatbot.	

UNIT V: COMPUTER VISION & INTELLIGENT SOLUTIONS	**9 Hrs.**
Introduction to Computer Vision - Computer vision - Computer vision fundamentals - Exercise: Using a basic deep neural network to solve an image recognition problem. Designing and building an intelligent solution - Designing and building an intelligent solution - Optional Exercise: Integrating IBM Watson Knowledge Studio with IBM Watson Discovery for the procurement domain.	

Total Hours: 45

TEXT BOOKS:	
1.	Artificial Intelligence – Practitioner Course © Copyright International Business Machines Corporation, New Orchard Road, 2019. US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

2.	Stuart Russell & Peter Norvig," Artificial Intelligence: A Modern Approach", Pearson, 2021.
3.	Keras & TensorFlow Aurélien Géron "Hands-On Machine Learning with Scikit-Learn", O'Reilly, 2022.

REFERENCE BOOKS:	
1.	Artificial Intelligence by Puntambekar and Publication: Tech- Max Publication.
2.	Artificial Intelligence by Rich and Author: Rich, E/ Knight, Edition: 2nd ed and Publication: Tata McGraw Hill publication (TMH).
3.	Artificial Intelligence: A Modern Approach by Russell and Author: Russell, S/ Norvig, P. Publication: Pearson Education
4.	Applied Artificial Intelligence: A Handbook for Business Leaders By – Mariya Yao, Adelyn Zhou, Marlene Jia
5.	Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer.

WEB REFERENCES:	
1.	Deep learning for computer vision https://nptel.ac.in/courses/106106224
2.	Introduction to Machine Learning https://onlinecoursesarchive.nptel.ac.in/noc17cs26/preview
3.	Natural language processing https://nptel.ac.in/courses/106105158

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

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

BoS Chairman

PROFESSIONAL ELECTIVE COURSES

Professional Elective – IV (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 Cyber Security

BoS Chairman

U23CE7T21	Cognitive Computing	L	T	P	C	Total
		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 – 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

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	–	–	2	1	1	–	–	–	–	2	3	1	1
2	3	3	2	2	3	–	–	1	1	1	–	2	3	2	2
3	3	3	2	3	3	–	1	–	1	1	–	2	3	3	2
4	2	3	3	2	3	2	1	2	1	1	1	2	3	2	3
5	2	3	3	3	3	3	2	2	1	1	1	2	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 – 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.	Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy”, Elsevier (Syngress), 3rd Edition, 2021.
2.	Michael T. Simpson, Kent Backman and James Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, 4th Edition, 2022.

REFERENCE BOOKS:	
1.	Daniel G. Graham, “Ethical Hacking: A Hands-on Introduction to Breaking In”, No Starch Press, 2021.

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

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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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4	3	3	3	3	3	2	1	3	1	1	1	2	3	3	3
5	3	3	3	2	3	3	2	3	2	2	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	Total
		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.	

Total Hours: 45

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
6	https://www.simplilearn.com/what-is-data-mining-article

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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4	3	3	3	3	3	1	1	1	1	2	1	2	3	3	3
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Correlation Level: 1-Low, 2-Medium, 3- High, ‘-' - no correlation

BoS Chairman

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

COURSE OBJECTIVES:

• To understand the principles and applications of Design Thinking for innovative problem solving.
• To learn DevOps concepts, tools, and practices for modern software development.
• To develop skills in DevOps automation, cloud computing, containerization, and DevSecOps.
• To understand Agile and Scrum methodologies for effective project management.
• To apply Agile testing, quality assurance, and collaboration tools for software delivery.

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.	

Total Hours: 45

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

BoS Chairman

U23AD7T23	Reinforcement Learning	L	T	P	C	Total
		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.	

Total Hours: 45

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=YUbFQlMXShY
3	https://www.coursera.org/articles/what-is-a-markov-decision-process
4	https://nptel.ac.in/courses/106106143

COs/POs/ PSOs Mapping:

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
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Correlation Level: 1-Low, 2-Medium, 3- High, ‘-' - no correlation

BoS Chairman

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

COURSE OBJECTIVES:

• To understand the fundamental concepts of Artificial Intelligence, Machine Learning, and Deep Learning applied to healthcare and medical decision-making
• To apply computer vision and medical image analysis techniques for disease detection, diagnosis, and segmentation of medical images such as MRI scans
• To develop and evaluate prognostic models, survival analysis techniques, and risk prediction systems for healthcare applications
• To analyze treatment outcomes and estimate treatment effects using advanced machine learning approaches for personalized medicine
• To design intelligent healthcare solutions that support clinical decision-making while considering reliability, validation, ethical practices, and patient-centered care.

COURSE OUTCOMES:

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

CO1:	Explain the fundamental concepts of computer vision and deep learning techniques for disease detection and medical image analysis.
CO2:	Evaluate AI models using appropriate performance metrics and validation techniques in healthcare applications.
CO3:	Develop and analyze medical image segmentation models using U-Net architectures and MRI datasets.
CO4:	Apply prognostic and survival analysis models for healthcare risk prediction and decision support.
CO5:	Design AI-based treatment effect estimation and personalized healthcare solutions using advanced machine learning techniques.

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 – 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 – 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://docs.monai.io/
3.	https://pytorch.org/ecosystem/#medical-and-healthcare
4.	https://www.cancerimagingarchive.net/
5.	https://www.nlm.nih.gov/

COs/POs/PSOs Mapping:

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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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 – 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.

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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:

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	–	–	2	2	1	3	–	1	–	2	3	1	2
2	3	3	2	3	3	2	1	3	1	1	–	2	3	3	3
3	3	3	2	2	3	3	1	3	1	1	1	2	3	3	3
4	3	3	3	3	3	2	1	3	1	2	1	2	3	3	3
5	3	3	3	3	3	3	2	3	2	2	2	2	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.	American Society for Quality (ASQ) – Quality Management Resources, https://asq.org/quality-resources/quality-tools
2.	Six Sigma Official Resources – Six Sigma Methodologies and DMAIC Concepts-https://www.isixsigma.com/category/capability-indices-process-capability/
3.	International Organization for Standardization (ISO) – Environmental Management Systems
4.	(ISO 14001)-https://www.iso.org/iso-14001-environmental-management.html
5.	NIST Manufacturing Extension Partnership – Lean Manufacturing and Process Improvement

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

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

BoS Chairman

U23CM7T01	Intellectual Property Rights and 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	**9 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: TYPES OF INTELLECTUAL PROPERTY RIGHTS	9 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: IPR MANAGEMENT AND LEGAL FRAMEWORK	9 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: BUSINESS ETHICS AND CORPORATE GOVERNANCE	9 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: Corporate Social Responsibility and Ethical Issues in Business	9 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)		
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2	2	3	1	1	1	2	1	2	–	1	–	2	1	2	2
3	2	3	2	2	2	3	1	3	1	2	2	2	1	2	3
4	1	3	2	2	1	3	2	3	1	2	1	2	1	2	2
5	1	3	2	2	1	3	3	3	2	2	2	2	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	Total
		0	0	12	6	180

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 Phase-I:

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.

Total Hours: 180

Guideline for Assessment of Project Phase -I / Oral Examination:

1. At the end of the course duration, each team will submit a presentation of minimum 10-15 slides in.pdf file, a video of one min to showcase their project and a printed report of minimum 40 pages.

Project phase 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.	

Total Hours: 30

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: CASE STUDIES	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 11th 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, 4th 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

BoS Chairman

U23UM7P33	Green Credit - VII	L	T	P	C	Total
		0	0	2	1	15

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