Dr. D. Y. Patil Educational Federation's
Dr. D. Y. Patil College of Engineering and Innovation
APPROVED BY AICTE, RECOGANIZED BY GOVT. OF MAHARASHTRA,
AUTONOMOUS INSTITUTE AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSITY
Accredited by NAAC with "A" Grade

ACADEMIC COURSE STRUCTURED
AND
DETAILED SYLLABUS

Multidisciplinary Minor – Common to all

BTech 4 YEAR UG COURSE

(Applicable for the batches admitted from AY 2025-2026 at FY)

Dr. D. Y. Patil College of Engineering & Innovation

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Multidisciplinary Minor – Common to all (Semester –III)

MDM-I (ILMDM201T)	
ILMDM201T-1	Smart cities and intelligent infrastructure
ILMDM201T-2	Fundamentals of autonomy and intelligent behaviour
ILMDM201T-3	Introduction to smart and precision agriculture
ILMDM201T-4	Fundamentals of electric vehicles and comparison with ICE vehicles
ILMDM201T-5	Fundamentals of additive manufacturing
ILMDM201T-6	Fundamentals of healthcare systems and digital health
ILMDM201T-7	Microcontrollers and Industrial Applications

Multidisciplinary Minor – Common to all (Semester –IV)

MDM-II (ILMDM202T)	
ILMDM202T-1	Sustainable energy and environment
ILMDM202T-2	Perception, sensing, and sensor fusion
ILMDM202T-3	Robotics and automation in farming operations
ILMDM202T-4	Electric powertrain architecture and motor technologies
ILMDM202T-5	3D printing processes: FDM, SLA, SLS, DMLS, Binder Jetting, etc.
ILMDM202T-6	AI techniques (ML, DL, NLP, CV) in diagnostics and prognosis
ILMDM202T-7	Introduction to Embedded Processors

Multidisciplinary Minor – Common to all (Semester –III)

Syllabus

Second Year (2025 Course) Smart cities and intelligent infrastructure			
Course Code	ILMDM201T-1	**Credit**	02
Contact Hours	02 Hrs/weeks (L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Python Programming

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	To understand the concept, architecture, and components of smart cities
2	To explain how intelligent infrastructure benefits for urban services
3	To evaluate sustainability, governance, privacy, and resilience issues in smart cities.
4	To analyze smart solutions for transportation, energy, water, waste, and safety.
5	To apply IoT, GIS, data analytics, and AI concepts in smart cities

Course Outcomes	
1	Remember the concepts, features, and planning principles of smart cities
2	Understand the working of urban infrastructure systems and their smart upgrades.
3	Evaluate governance, sustainability, security, and ethical issues in smart cities.
4	Analyze intelligent solutions for mobility, utilities, and public services.

5	Apply sensor, IoT, GIS, and communication technologies in smart infrastructure.

Topics covered:

UNIT-I: Introduction to Smart Cities and Urban Systems (5 Hrs)

Urbanization and need for smart cities, Definitions, characteristics, and goals of smart cities, Components of a smart city, **Urban infrastructure**: physical, digital, social, and institutional infrastructure, Smart city planning principles, Area-based development and pan-city development concepts, Role of citizens, government, industry, and academia, Smart city indicators and performance measures.

UNIT-II: Smart Urban Infrastructure Systems (5 Hrs)

Smart water supply and water quality monitoring, Smart drainage, sewerage, and storm-water systems, Smart solid waste management, Smart energy systems and smart grids, Smart Street lighting and energy-efficient public infrastructure Smart buildings and green buildings, **Urban mobility and public transportation systems**

Infrastructure lifecycle: planning, operation, maintenance, and upgrading

UNIT-III: Enabling Technologies for Intelligent Infrastructure (5 Hrs)

Internet of Things (IoT) for smart cities, Sensors, actuators, RFID, embedded systems, Communication technologies: Wi-Fi, LoRa, 5G, LPWAN, NB-IoT

Geographic Information Systems (GIS) and remote sensing, Cloud computing and edge computing in urban services, Cyber-Physical Systems (CPS), Digital twins for infrastructure monitoring, **Open data platforms and urban dashboards**, Integrated Command and Control Centre (ICCC) concepts

UNIT-IV: Intelligent Applications and Analytics in Smart Cities (5 Hrs)

Data collection, urban data models, and data integration Basics of big data analytics for smart cities Artificial Intelligence and Machine Learning applications **Intelligent Transportation Systems (ITS)** Traffic monitoring, smart parking, route optimization Predictive maintenance of public assets Smart healthcare, public safety, and emergency response systems, **Smart environmental monitoring**: air quality, noise, weather, disaster alerts Decision support systems for city administration

UNIT-V: Governance, Sustainability, Security, and Case Studies (5 Hrs)

Smart governance and e-governance, Citizen participation and inclusive development, **Sustainable and climate-resilient infrastructure**, Urban resilience and disaster preparedness, Data privacy, cybersecurity, and ethics, **Financing models for smart-city projects**, Standards, policies, and implementation challenges Indian and global smart-city case studies**, Mini-project / case-based solution design**

Text Books:

1. "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", Anthony M. Townsend
2. "Smart Cities and Urban Development", Vinod Kumar Jain
3. "Smart Cities: Foundations, Principles and Applications", Houbing Song, Ravi Srinivasan, Tamim Sookoor, Sabina Jeschke
4. " Smart Cities: Development and Governance Frameworks", Zaigham Mahmood

Reference Books:

1. "Smart Cities and the Future Internet", Schaffers et al.
2. "Smart Cities", Germaine Halegoua.
3. Selected research papers on smart infrastructure, IoT, GIS, and urban analytics
4. Government reports and smart-city mission documents

MOOC Course:

"Smart Cities"- By Prof. Neelima Satyam, Prof. Priyansh Singh | IIT Indore--**NPTEL**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	1	-	-	1	-
CO2	2	3	1	1	2	2	1	-	-	1	-
CO3	2	2	2	1	3	1	-	-	-	1	-
CO4	2	3	2	2	2	2	1	-	-	1	-
CO5	1	2	-	1	1	3	3	2	-	1	1

Second Year (2025 Course) Fundamentals of Autonomy and Intelligent Behavior			
Course Code	ILMDM201T-2	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Mathematics and Fundamental Programming (Python/C++).

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	Define and distinguish autonomy from automation, and analyze the "sense-think-act" closed-loop architecture
2	Evaluate methods for sensor data processing (LIDAR, cameras), localization, and Simultaneous Localization and Mapping (SLAM).
3	Apply machine learning, reinforcement learning, and planning algorithms (e.g., path planning, navigation) for decision-making under uncertainty.
4	Analyze ethical, legal, and safety considerations (fail-safe mechanisms) for deploying autonomous systems, particularly in robotics or vehicles
5	Combine hardware (sensors/actuators) and software (control systems) to build fully functional autonomous agents or robots.

Course Outcomes	
1	Illustrate the essential concepts of autonomy, intelligent agents, and environmental interaction.

2	Model the perception and localization functions of autonomous systems through SLAM and sensor fusion methods
3	Apply planning and decision-making techniques to enable navigation in dynamic environments
4	Evaluate the safety, security, and ethical concerns related to autonomous system deployment
5	Demonstrate the use of reinforcement learning techniques for autonomous decision-making and behavior

Topics covered:

UNIT-I: Introduction to Smart Cities and Urban Systems (6 Hrs)

Urbanization and need for smart cities: Definitions, characteristics, and goals of smart cities, Components of a smart cities. **Urban infrastructure:** physical, digital, social, and institutional infrastructure, Smart city planning principles, Area-based development and pan-city development concepts, **Role of citizen government**, industry, and academia, Smart city indicators and performance measures.

UNIT-II: Smart Urban Infrastructure Systems (5 Hrs)

Smart water supply and water quality monitoring, Smart drainage, sewerage, and storm-water systems, Smart solid waste management, **Smart energy systems** and smart grids, Smart street lighting and energy-efficient public infrastructure Smart buildings and green buildings.

UNIT-III: Enabling Technologies for Intelligent Infrastructure (6 Hrs)

Internet of Things (IoT) for smart cities, Sensors, actuators, RFID, embedded systems, Geographic Information Systems (GIS) and remote sensing, Cloud computing and edge computing in urban services, Cyber-Physical Systems (CPS), Digital twins for infrastructure monitoring.

Webservers Protocols Introduction- Web Socket, MQTT, CoAP etc.

UNIT-IV: Intelligent Applications and Analytics in Smart Cities (6 Hrs)

Data collection, urban data models, and data integration Basics of big data analytics for smart cities. Artificial Intelligence and Machine Learning applications.

Intelligent Transportation Systems (ITS) Traffic monitoring, smart parking, route optimization, Predictive maintenance of public assets Smart healthcare, public safety, and emergency response systems, Smart environmental monitoring: air quality, noise, weather, disaster alerts Decision support systems for city administration.
UNIT-V: Governance, Sustainability, Security, and Case Studies (7 Hrs) Smart governance and e-governance, Citizen participation and inclusive development, Sustainable and climate-resilient infrastructure, Urban resilience and disaster preparedness, Data privacy, cybersecurity **Case Studies:** Smart Transportation, Smart Grid, Smart Industry etc.

Text Books:

1. Smart Cities: Concepts, Practices, and Applications, Krishna Kumar et al., CRC Press, 2022
2. Smart Living for Smart Cities: Community Study, Ways and Means ,T. M. Vinod Kumar , Springer, 2020

Reference Books:

1. R. John Glasson, A. Theriveland and R. Chandwic, Introduction to Environmental Impact Assessment, Taylor and Francis, 2011, ISBN: 978-0415664707
2. R. John Glasson, A. Theriveland and R. Chandwic, Introduction to Environmental Impact Assessment, Taylor and Francis, 2011, ISBN: 978-0415664707
3. Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principles and Architectures, CRC Press.

MOOC Course:

Autonomous Ground Vehicles and Intelligent Control - Course (nptel.ac.2in)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-
CO3	2	3	-	1	-	3	3	1	-	-	-
CO4	2	3	2	2	2	-	1	1	-	-	-
CO5	2	2	3	2	3	-	1	1	-	-	3

Second Year (2025 Course) Introduction to Smart and Precision Agriculture			
Course Code	ILMDM201T-3	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Basics of agriculture, environmental studies, sensors, communication basics, and computer fundamentals.

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	Understand the concept, scope, and importance of smart and precision agriculture.
2	Explain the role of sensors, IoT, GIS, GPS, drones, and automation in agriculture.
3	Analyze smart techniques for soil, water, crop, and nutrient management.
4	Apply data collection, monitoring, and decision-support concepts in agriculture.
5	Evaluate sustainability, economic benefits, and implementation challenges of precision farming.

Course Outcomes	
CO1	Describe the concepts, features, and need for smart and precision agriculture.

CO2	Illustrate how sensors, IoT, GIS, GPS, and drones support agricultural systems
CO3	Analyze smart methods for irrigation, soil monitoring, and crop management.
CO4	Apply data-driven tools and techniques for agricultural monitoring and decision support.
CO5	Evaluate sustainability, economic feasibility, and challenges in precision agriculture.

Topics covered:
UNIT-I: Fundamentals of Smart and Precision Agriculture (5 Hrs) Agriculture in the modern era, need for smart and precision agriculture, conventional farming versus precision farming, site-specific crop management, components of precision agriculture systems, role of data in farming, benefits and challenges of smart farming, sustainable agriculture and resource optimization.
UNIT-II: Sensors, IoT, and Communication in Agriculture (5 Hrs) Agricultural sensors: soil moisture, temperature, humidity, pH, nutrient, and weather sensors, actuators and control devices, Internet of Things (IoT) in agriculture, wireless sensor networks, communication technologies: Wi-Fi, Bluetooth, LoRa, GSM, NB-IoT, smart irrigation and farm monitoring systems.
UNIT-III: GIS, GPS, Remote Sensing, and Drone Applications (5 Hrs) GIS and GPS in agriculture, field mapping, remote sensing for crop monitoring, satellite imagery and vegetation indices, drones/UAVs in agriculture, applications in spraying, crop health monitoring, yield estimation, variable rate technology, geospatial decision support in farming.
UNIT-IV: Smart Crop, Soil, and Water Management (5 Hrs) Soil health monitoring, precision irrigation and fertigation, crop growth monitoring, nutrient management and variable application methods, pest and disease detection using smart tools, greenhouse and protected cultivation automation, weather-based advisory systems, yield prediction and farm decision support.
UNIT-V: Data Analytics, Automation, Sustainability, and Case Studies (5 Hrs) Agricultural data collection and management, basics of data analytics in farming, AI and machine learning applications in agriculture, farm automation and robotics

basics, sustainability and environmental impact of precision farming, economic feasibility and adoption challenges, Indian and global case studies in smart agriculture.

Text Books:

1. "Precision Agriculture Technology for Crop Farming", Qin Zhang
2. "Precision Agriculture", John V. Stafford
3. "Handbook of Precision Agriculture: Principles and Applications", Ancha Srinivasan
4. "Selected standard references on agricultural machines and precision agriculture"

Reference Books:

1. Books and manuals on agricultural sensors, remote sensing, and farm automation
2. Selected research papers on smart farming, IoT in agriculture, GIS, and drone applications
3. References on sustainable agriculture and digital farming systems
4. Case studies on precision farming and smart agriculture implementation

MOOC Course:

1. "Smart Agriculture / Precision Agriculture" – NPTEL / SWAYAM

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	2	-	-	1	-
CO2	3	2	1	1	3	1	2	-	-	1	-
CO3	2	3	2	1	2	1	2	-	-	1	-
CO4	2	3	2	2	2	1	2	-	-	1	-
CO5	2	2	1	2	1	3	3	1	-	1	1

Second Year (2025 Course) Fundamentals of electric vehicles and comparison with ICE vehicles			
Course Code	ILMDM201T-4	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Basic Electrical Engineering, Engineering Physics, Basic Electronics, Fundamentals of Mechanical Engineering, Mathematics (Basic Level), Environmental Studies (Basic Understanding)

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	To understand the fundamentals and evolution of electric vehicles (EVs).
2	To study components and working principles of EV systems.
3	To analyze battery technologies and energy storage systems.
4	To compare electric vehicles with internal combustion engine (ICE) vehicles.
5	To explore charging infrastructure, environmental impact, and future trends.

Course Outcomes	
CO1	Discuss the basic principles and different types of electric vehicles
CO2	Describe EV components such as motor, battery, and power electronics.
CO3	Analyze battery systems and charging mechanisms.

CO4	Analyze the differences between electric vehicles and ICE vehicles with respect to performance, efficiency, and emissions.
CO5	Evaluate future trends, challenges, and policies in EV technology.

Topics covered:
UNIT-I: Introduction to Electric Vehicles. (6 Hrs) Evolution of electric vehicles; Types of EVs: BEV, HEV, PHEV, FCEV; EV architecture and classification; Global and Indian EV scenario; Government policies and initiatives; Basics of mobility and sustainability
UNIT-II: Fundamentals of Electric Vehicle Systems (6 Hrs) Electric motor types: BLDC, PMSM, Induction motor; Battery technology: Lithium-ion, solid-state; Power electronics: converters, inverters; EV drivetrain and transmission; Regenerative braking system; Energy management systems.
UNIT-III: Battery Management & Charging Systems (6 Hrs) Battery characteristics and performance; Battery Management System (BMS); Charging methods: AC, DC fast charging, wireless charging; Charging standards (CCS, CHAdeMO, Bharat EV); Thermal management of batteries; EV infrastructure and grid integration.
UNIT-IV: Comparison of EV and ICE Vehicles (6 Hrs) Working principle of ICE vehicles: EV vs ICE comparison: Energy source, Efficiency, Emissions, Maintenance, Cost and performance; Mechanical complexity: ICE: engine, gearbox, exhaust system, EV: fewer moving parts, simpler drivetrain; Lifecycle analysis (environmental impact).
UNIT-V: Future Trends and Challenges in EVs (6 Hrs) Emerging technologies (solid-state batteries, V2G); Smart mobility and autonomous Evs; Environmental impact and sustainability; Challenges: cost, range anxiety, charging infrastructure; Policies and global trends; EV industry growth and innovation.

Text Books:

1. "Electric Vehicle Technology Explained", Authors: James Larminie, John Lowry
2. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", Author: Mehrdad Ehsani

3. "Electric Powertrain: Energy Systems, Power Electronics and Drives", Authors: John G. Hayes, G. Abas Goodarzi
4. "Hybrid Electric Vehicles: Principles and Applications", Author: Chris Mi
5. "Fundamentals of Electric Vehicles", Author: Sandeep Dhameja

Reference Books:

1. "Electric Powertrain: Energy Systems, Power Electronics and Drives" – John G. Hayes, G. Abas Goodarzi
2. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles" – Mehrdad Ehsani
3. "Electric Vehicle Technology Explained" – James Larminie, John Lowry
4. "Fundamentals of Electric Vehicles" – Sandeep Dhameja
5. "Hybrid Electric Vehicles: Principles and Applications" – Chris Mi

EBooks:

1. Electric Vehicle Technology Explained (2nd Edition eBook)
2. Free/Introductory EV Guide (Beginner Friendly)

MOOC Course:

1. "Fundamentals of Electric vehicles: Technology & Economics", By Prof. Ashok Jhunjhunwala, Prof. Kaushal Jha, Prof. L Kannan, Prof. Prabhjot Kaur, IIT Madras

CO-PO Mapping:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	–	–	2	–	–	1	–
CO2	3	2	2	–	2	–	1	–	–	–	–
CO3	3	3	2	2	2	–	2	–	–	–	–
CO4	3	3	1	2	–	2	3	–	–	1	–
CO5	2	2	1	1	–	3	3	2	1	1	1

Second Year (2025 Course) Fundamentals of Additive Manufacturing			
Course Code	ILMDM201T-5	**Credit**	02
Contact Hours	**TH:** 02 Hrs./Weeks(L)	**Type of Course**	Lecture
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

Pre-requisites: - Computer Aided Design & Drafting Engineering Materials

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To introduce the fundamental concepts, evolution, and classifications of Additive Manufacturing (AM).
2	To understand major AM processes- FDM, SLA. Their parameters and industrial applications.
3	To understand major AM processes- SLS, DMLS, BJ. Their parameters and industrial applications.
4	To explore post-processing and applications of AM in various sectors.
5	To apply the 3D printing process into various applications.

Course Outcomes	
CO1	Illustrate the core concepts and classifications of various Additive Manufacturing (AM) technologies.
CO2	Analyze the working principles and application scope of major AM processes like FDM and SLA
CO3	Describe the working principles, capabilities, limitations, and applications of major AM processes like SLS, DMLS, and BJ.
CO4	Apply knowledge of AM technologies and materials to identify suitable options for specific industrial applications

CO5	Apply 3D printing technology to produce a functional product.

Topics covered:
UNIT-I: 3D Printing (Additive Manufacturing) (6 Hrs.)
Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications.
UNIT-II: CAD for Additive Manufacturing (6 Hrs.)
CAD Data formats, Data translation, Data loss, STL format.
UNIT-III: Additive Manufacturing Techniques (6 Hrs.)
Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.
UNIT-IV: Materials (6 Hrs.)
Polymers, Metals, Non-Metals, Ceramics Process, Process parameter, Process Selection for various applications. Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.
UNIT-V: Additive Manufacturing Equipment (6 Hrs.)
Process Equipment- Design and process parameters. Governing Bonding Mechanism. Common faults and troubleshooting. Process Design. Post Processing: Requirement and Techniques - Support Removal, Sanding, Acetone treatment, polishing. Product Quality- Inspection and testing, Defects and their causes.

Text Books	
1	Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
Reference Books	
1	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
E- Books	

1	https://onlinecourses.nptel.ac.in/noc22_me122/preview

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1		1	-	-	-	-	-	-	1
CO2	2	3	1	3	1	-	-	-	-	-	1
CO3	3	2		3	-	-	-	-	-	-	1
CO4	2	2	3	2	-	-	-	-	-	-	1
CO5	2	-	3	1	3			2	1	1	1

Second Year (2025 Course) Fundamentals of Healthcare System and Digital Health			
Course Code	ILMDM201T-6	**Credit**	02
Contact Hours	**TH:** 02 Hrs./Weeks(L)	**Type of Course**	Lecture
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

Pre-requisites: -

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To Understand the basic structure and functioning of healthcare systems.
2	To Learn the role of digital technologies in healthcare delivery.
3	To Study electronic health records, telemedicine, and health information systems.
4	To Explore healthcare data management, analytics, and security issues.
5	Understand emerging digital health tools such as IoT, AI, and wearable systems.

Course Outcomes	
CO1	Explain the structure, components, and functioning of healthcare systems
CO2	Describe the concepts, scope, and significance of digital health in modern healthcare systems
CO3	Illustrate the design and use of health information systems and digital medical records.
CO4	Analyze how healthcare data is managed, protected, and used for decision-making
CO5	Illustrate modern and emerging technologies used in digital healthcare applications

Topics covered:
UNIT-I: Introduction to Healthcare Systems (6 Hrs.)
Overview of healthcare systems, Types of healthcare services: primary, secondary, tertiary care, Public and private healthcare systems , Roles of hospitals, clinics, laboratories, pharmacies, and diagnostic centers, Healthcare professionals and stakeholders, Healthcare workflow and patient journey, Challenges in healthcare delivery , Importance of technology in healthcare
UNIT-II: Fundamentals of Digital Health (6 Hrs.)
Introduction to digital health, Evolution of digital health technologies, e-Health, m-Health, telehealth, and telemedicine, Digital transformation in healthcare , Benefits and limitations of digital health , Applications of ICT in healthcare, Smart healthcare ecosystem , Role of computer engineers in digital health solutions
UNIT-III: Health Information Systems and Electronic Health Records (6 Hrs.)
Health Information System (HIS): concept and components, Hospital Management Information System , Electronic Health Records (EHR) and Electronic Medical Records (EMR), Clinical data, patient records, and health databases , Data standards in healthcare , Interoperability in healthcare systems , Medical coding basics , Case studies of digital record systems
UNIT-IV: Healthcare Data, Security, and Analytics (6 Hrs.)
Types of healthcare data: structured and unstructured , Data collection from hospitals, labs, sensors, and wearables , Basics of healthcare data analytics , Data visualization in healthcare , Privacy, confidentiality, and ethical issues in healthcare data, Cybersecurity in digital health systems , Data protection and secure storage Introduction to regulatory and legal aspects in digital health
UNIT-V Emerging Technologies in Digital Health (6 Hrs.)
Internet of Things (IoT) in healthcare, Wearable devices and remote patient monitoring, Artificial Intelligence and Machine Learning in healthcare, Mobile applications for health monitoring, Cloud computing in healthcare systems, Big data applications in healthcare, Robotics and automation in healthcare, Future trends in digital health and smart hospitals

Text Books	
1	Artificial Intelligence and Machine Learning in Healthcare – Dharmendra Kumar Yadav, Anamika Gulati.
2	Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes – Arjun Panesar.
3	Artificial Intelligence and Machine Learning in Healthcare (Latest Edition) – Arman Kilic

Reference Books	
1	"Artificial Intelligence in Healthcare" by Adam Bohr & Kaveh Memarzadeh
2	"Deep Learning for Medical Image Analysis" by S. Kevin Zhou, Hayit Greenspan, Dinggang Shen
3	"Machine Learning and AI for Healthcare" by Arjun Panesar
4	"Artificial Intelligence in Medicine" by Lei Xing & James Orloff
E- Books	
1	https://nptel.ac.in/courses/106/108/106108101/

CO-PO Mapping Table

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	2	-	-	-	-	1
CO2	3	-	-	-	2	2	-	-	-	-	1
CO3	2		2		3	1	2	-	-	-	1
CO4	1	-	-	1	2	2	-		1	-	1
CO5	2	3	1		3	2	-	-	-	-	2

Second Year (2025 Course) Microcontrollers and Industrial Application			
Course Code	ILMDM201T-7	**Credit**	02
Contact Hours	**TH:** 02 Hrs./Weeks(L)	**Type of Course**	Lecture
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

TOP

Pre-requisites: - Digital Electronics, Microprocessors & Microcontrollers, Basic Embedded Systems

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To introduce the fundamental concepts of embedded systems and the classification of embedded processors.
2	To develop understanding of the architecture and programming model of embedded processors.
3	To provide knowledge of ARM processor architecture, instruction sets, and interfacing techniques.
4	To enable students to study and compare embedded processors for real-time application requirements.
5	To develop the ability to design and analyze real-time embedded system applications using ARM-based processors and embedded operating systems.

Course Outcomes	
CO1	Understand embedded system fundamentals and processor classifications.
CO2	Explain architecture and programming model of embedded processors.
CO3	Analyze ARM processor architecture, instruction sets, and interfacing mechanisms.
CO4	Evaluate embedded processor selection for real-time embedded applications.
CO5	Design and analyze real-time embedded system applications using ARM-based processors and embedded operating systems.

Topics covered:

UNIT-I: Introduction to Microcontrollers (6 Hrs.)
Overview of Microcontrollers, Microcontroller vs Microprocessor. Architecture of 8051 microcontroller. Block diagram, CPU, Memory organization, I/O Ports, Timers/Counters, Serial Communication, Interrupts. Introduction to Microchip Technology PIC Microcontrollers.
UNIT-II: Advanced Microcontrollers (6 Hrs.)
Overview of ARM Cortex-M4 architecture. GPIO Programming, Timers, ADC, DAC, PWM. Interrupt Handling and Nested Vector Interrupt Controller (NVIC). Low-power modes and Power management.
UNIT-III: Industrial Interfacing and Communication (6 Hrs.)
Industrial Sensors and Actuators. Signal Conditioning, Relay, Opto-isolator. Communication Protocols: UART, SPI, I2C. Industrial Communication Standards: MODBUS, CAN bus, RS-485.
UNIT-IV: Industrial Automation Systems (6 Hrs.)
Introduction to PLC and SCADA systems. Overview of Supervisory Control and Data Acquisition (SCADA). Distributed Control Systems (DCS). Embedded Control in Manufacturing Systems. Industrial Safety and Standards.
UNIT-V Real-Time Industrial Applications (6 Hrs.)
Real-Time Embedded Control Systems. Motor Control using Microcontrollers. Temperature and Process Control Systems. IoT in Industrial Automation. Case Study: Microcontroller-based Industrial Automation System.

Text Books	
1	The 8051 Microcontroller and Embedded Systems – Mazidi & Mazidi.
2	PIC Microcontroller and Embedded Systems – Muhammad Ali Mazidi.
3	ARM Microcontroller and Embedded Systems – Valvano.
Reference Books	
1	The Definitive Guide to ARM Cortex-M3 – Joseph Yiu.
2	Embedded Systems: Architecture, Programming and Design – Raj Kamal.
3	Industrial Automation and Control – S. K. Singh.
E- Books	
1	Embedded Systems: Introduction to ARM Cortex-M Microcontrollers – Jonathan Valvano (Free PDF available online).
2	ARM University Program – Embedded Systems Fundamentals (Open Educational Resource).

3	Microcontroller Architecture Programming and Applications with 8051 – Online PDF resources (educational use).

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	-	-	-	-	-	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	3	2	3	3	3	-	-	1	-	-	-
CO5	3	3	3	3	2	-	-	-	2	2	-

Multidisciplinary Minor – Common to all (Semester –IV)

Syllabus

Second Year (2025 Course) Sustainable Energy and Environment			
Course Code	ILMDM202T-1	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

Pre-requisites: Environmental Studies, Basic Physics and Chemistry, Engineering Mathematics, Basic Electrical and Mechanical Engineering concepts

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	Understand sustainable energy and environmental protection concepts.
2	Explain conventional and renewable energy resources and applications.
3	Analyze solar, wind, biomass, hydro, hydrogen, and storage systems.
4	Apply energy conservation, energy management, and assessment concepts.
5	Evaluate sustainability, pollution control, climate impact, and green technologies.

Course Outcomes	
1	Describe sustainable development, energy demand, and environmental concerns.
2	Explain conventional and renewable energy systems and working principles.
3	Analyze renewable energy technologies and storage methods.

4	Apply energy conservation and energy audit concepts in practice.
5	Evaluate impacts of energy systems and propose sustainable solutions.

Topics covered:
UNIT-I: Fundamentals of Sustainable Energy and Environment (6 Hrs) Energy scenario, sustainability, energy–environment–economy relationship, conventional resources, environmental effects, climate change, global warming, carbon emissions, ecological footprint.
UNIT-II: Renewable Energy Resources (6 Hrs) Solar thermal and photovoltaic systems, wind energy, hydropower, biomass and waste-to-energy, geothermal and ocean energy, hydrogen energy and fuel cells, merits and limitations of renewables.
UNIT-III: Energy Conversion, Storage, and Management (6 Hrs) Energy conversion, renewable power generation, distributed generation, hybrid systems, batteries, pumped, thermal and hydrogen storage, grid integration, microgrids, demand-side management, energy economics.
UNIT-IV: Energy Conservation and Environmental Management (6 Hrs) Energy conservation, efficiency in buildings, industries and transport, energy audit, cleaner production, air, water, soil and noise pollution, solid and hazardous waste management, EIA.
UNIT-V: Sustainable Technologies, Policy, and Case Studies (6 Hrs) Green buildings, sustainable infrastructure, electric mobility, circular economy, low-carbon development, carbon footprint reduction, energy policy, renewable missions, and Indian and global case studies.

Text Books:

1. "Non-Conventional Energy Sources", G. D. Rai
2. "Solar Energy: Principles of Thermal Collection and Storage", S. P. Sukhatme and J. K. Nayak
3. "Non-Conventional Energy Resources", B. H. Khan
4. "Environmental Pollution Control Engineering", C. S. Rao

Reference Books:

1. "Renewable Energy Resources", Twidell and Weir
2. "Renewable Energy: Power for a Sustainable Future", Boyle
3. "Renewable Energy Sources and Emerging Technologies", Kothari, Singal and Ranjan
4. Selected research papers on sustainable energy, energy storage, environmental management, and green technologies

MOOC Course:

"Renewable Energy Engineering" **– NPTEL / SWAYAM**

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	2	3	1	-	1	-
CO2	3	2	1	-	1	2	3	-	-	1	-
CO3	2	3	2	1	2	1	2	-	-	1	-
CO4	2	3	2	2	2	1	2	-	-	1	-
CO5	2	3	1	2	1	3	3	2	-	1	1

Second Year (2025 Course) Perception, Sensing and Sensor Fusion			
Course Code	ILMDM202T-2	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Algebra (Mathematics) and Fundamental Programming (Python/C++).

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	Understand the fundamental principles of various sensors (cameras, LiDAR, Radar, IMU) and their operating characteristics.
2	Develop skills in processing raw sensor data and implementing computer vision algorithms for object detection and tracking.
3	Analyze the strengths and limitations of individual sensors and the necessity for fusion in dynamic environments.
4	Implement probabilistic data fusion algorithms, such as Kalman Filters and Bayesian filtering, to improve perception accuracy.
5	Evaluate different sensor fusion architectures (centralized vs. decentralized) for real-time applications.

Course Outcomes	
1	Classify and select appropriate sensors (cameras, LiDAR, Radar) based on application requirements.
2	Perform camera calibration and interpret LIDAR point clouds for object recognition.

3	Apply Kalman Filters and EKF to track objects in noisy environments.
4	Implement sensor fusion techniques (early/late) to improve situational awareness.
5	Design robust perception systems for intelligent vehicles or robotics.

Topics covered:
UNIT-I: Fundamentals of Sensing and Sensor Hardware (5 Hrs) **Introduction to Sensing:** Principles of sensing, sensor classification, and sensor terminology. **Perception Sensors:** Overview of passive (camera) vs. active sensors (LiDAR, Radar, Sonar). **Sensor Characteristics:** Sensitivity, range, resolution, accuracy, and noise characteristics. **Environmental Factors:** Impact of environmental variation (weather, illumination, occlusion) on sensor reliability.
UNIT-II: Vision-Based Perception (Camera Systems) (5 Hrs) **Camera Fundamentals:** Pinhole camera model, camera calibration (intrinsics and extrinsics). **Image Processing Basics:** Image filtering, edge detection, feature extraction (SIFT, SURF, ORB). **Stereo Vision and Depth Estimation:** Epipolar geometry, disparity maps, and 3D reconstruction. **Object Detection and Recognition:** Deep learning models for image classification, localization, and segmentation.
UNIT-III: Ranging and Mapping Sensors (LiDAR/Radar) (5 Hrs) **LiDAR Systems:** LiDAR point cloud data, preprocessing, clustering, and segmentation. **Radar Principles:** FMCW waveform, range-doppler estimation, and target detection. **Comparison and Applications:** Comparing LiDAR and Radar for object tracking and obstacle avoidance. **Local Positioning:** Introduction to Odometry and Inertial Measurement Units (IMU).
UNIT-IV: Principles of Sensor Fusion (5 Hrs) **Sensor Fusion Concepts:** Definition, benefits (redundancy, complementary), and challenges. **Fusion Levels:** Raw data fusion, feature-level fusion, and decision-level fusion. **Architectures:** Centralized vs. Decentralized fusion, and Distributed fusion systems. **Spatial and Temporal Alignment:** Sensor calibration and synchronization techniques.
UNIT-V: Data Fusion Algorithms and Tracking (5 Hrs) **Probabilistic Frameworks:** Bayesian estimation, Kalman Filters (KF) for linear

systems. **Non-linear Filtering:** Extended Kalman Filter (EKF) and Unscented Kalman Filter (UKF). **Multi-Object Tracking (MOT):** Data association (Nearest Neighbor, Global Nearest Neighbor). **Case Studies:** Fusion for autonomous navigation (camera-radar) and SLAM applications.

Text Books:

1. "Fundamentals of Sensor Fusion" Edmund Brekke
2. "AI-based Sensor Fusion for Perception in Autonomous Vehicles" Leichen Wang.

Reference Books:

1. "Multi-Sensor Data Fusion: An Introduction" H. B. Mitchell
2. "Mathematical Techniques in Multi-sensor Data Fusion" David L. Hall

MOOC Course:

Embedded Sensing, Actuation and Interfacing Systems - Course (nptel.ac.2in)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	2	3	3	2	3	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	2	2	3	3	2	-	-	-	-	-	-
CO5	-	2	-	3	1	-	-	-	-	-	-

Second Year (2025 Course) Robotics and Automation in Farming Operations			
Course Code	ILMDM202T-3	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Basic Programming Fundamentals and Elementary Mathematics

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	Understand the fundamentals of robotics used in agricultural operations.
2	Learn the principles of automation in farming activities.
3	Study sensors and actuators used in agricultural robots.
4	Analyze applications of robotic systems in crop production.
5	Evaluate benefits and challenges of automation in agriculture.

Course Outcomes	
1	Explain basic concepts of agricultural robotics.
2	Identify components of robotic farming systems.
3	Apply automation techniques for farming operations.
4	Analyze performance of robotic farming tools.
5	Design simple robotic-based farming solutions.

Topics covered:

UNIT-I: Fundamentals of Agricultural Robotics (6 Hrs) Introduction to robotics, Components of robots, Types of agricultural robots, Role of robotics in modern farming.
UNIT-II: Sensors and Actuators in Farming Robots (6 Hrs) Types of sensors used in agriculture, Actuators and motors, Control systems basics, Integration of sensors and actuators.
UNIT-III: Automation Technologies in Agriculture (6 Hrs) Introduction to automation, Automatic planting and harvesting systems, Greenhouse automation, Robotics in irrigation systems.
UNIT-IV: Autonomous Systems and Navigation (6 Hrs) Basic navigation techniques, GPS-based farming systems, Path planning basics, Autonomous vehicle concepts in farming.
UNIT-V: Applications and Future Trends (6 Hrs) Robotic weed control, Crop monitoring robots, AI in agricultural robotics, Future trends and challenges.

Text Books:

1. Qin Zhang, 'Agricultural Robotics: Fundamentals and Applications', CRC Press.
2. Simon Blackmore, 'Robotics and Automation in Agriculture', Springer.

Reference Books:

1. John Billingsley, 'Robotics in Agriculture', Wiley.
2. R. Siegwart, 'Introduction to Autonomous Mobile Robots', MIT Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	2	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-
CO4	2	3	3	2	2	-	-	-	-	-	-
CO5	-	2	3	3	1	-	-	-	-	-	-

Second Year (2025 Course) Electric powertrain architecture and motor technologies			
Course Code	ILMDM202T-4	**Credit**	02
Contact Hours	02 Hrs/weeks(L)	**Type of Course**	Lecture
Examination Scheme	CCE: 50 marks SSE: 50 marks	**Total Marks**	100

TOP

Pre-requisites: Basic Electrical Engineering, Electrical Machines, Power Electronics, Control Systems, Engineering Mathematics, Basics of Automotive Engineering

Course assessment methods/tools:

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Examination	External	50#

Course Objectives	
1	To understand the architecture and components of electric vehicle powertrains.
2	To study various electric motors used in EV applications and their characteristics.
3	To analyze power electronics and control strategies in EV powertrains.
4	To explore motor selection, sizing, and performance evaluation.
5	To gain knowledge of advanced motor technologies and future EV trends.

Course Outcomes	
1	Explain EV powertrain architectures and configurations.
2	Analyze working principles of various electric motors used in EVs.
3	Evaluate performance of motor drives and power electronic systems.
4	Select suitable motors for EV applications based on requirements.
5	Understand emerging motor technologies and optimization techniques.

Topics covered:
UNIT-I: Electric Powertrain Architecture. (6 Hrs) Introduction to EV powertrain; Types of EV architectures: BEV, HEV, PHEV; Series, Parallel and Series-Parallel configurations; Components of EV powertrain: Motor, Battery, Converter, Controller; Power flow and energy efficiency; Comparison with ICE powertrain
UNIT-II: Electric Motors for EV Applications (6 Hrs) Classification of motors: DC Motor, BLDC Motor, PMSM, Induction Motor, Switched Reluctance Motor (SRM); Torque-speed characteristics; Efficiency and performance curves; Motor selection criteria.
UNIT-III: Motor Drives and Power Electronics (6 Hrs) Power electronic devices: IGBT, MOSFET; Inverters and converters (DC-DC, DC-AC); Motor control techniques: Scalar control, Vector control; Regenerative braking; Drive cycles and performance analysis.
UNIT-IV: Motor Sizing, Thermal and Performance Analysis (6 Hrs) Motor sizing and rating calculations; Thermal management of motors; Cooling techniques (air, liquid); Efficiency optimization; Vehicle dynamics and tractive effort.
UNIT-V: Advanced Motor Technologies and Trends (6 Hrs) Advanced motors: Axial flux motors, Hub motors; Integrated drive systems (e-axle) AI-based motor control; Future trends in EV propulsion; Case studies of modern EV powertrains.

Text Books:

1. "Electric and Hybrid Electric Vehicles" – Iqbal Husain
2. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles" – Mehrdad Ehsani
3. "Electric Vehicle Technology Explained" – James Larminie & John Lowry

Reference Books:

1. "Fundamentals of Electric Vehicles" – Sandeep Dhameja
2. "Power Electronics in Electric Vehicles" – Ebrahim Babaei

3. "Electric Motor Drives: Modeling, Analysis, and Control" – R. Krishnan
4. "Hybrid Electric Vehicles: Principles and Applications" – Chris Mi

EBooks:

3. AICTE EV Course Modules (NEP-based EV curriculum)
4. MIT OpenCourseWare – Electric Vehicle Systems
5. IEEE Xplore Digital Library (EV Powertrain papers)
6. SAE International – EV Standards & Technical Papers

MOOC Course:

1. NPTEL Course: Electric Vehicles (IIT Faculty Lectures)

CO-PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	1	-
CO2	3	3	-	1	-	-	-	-	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-
CO5	2	2	1	1	2	-	1	-	-	-	-

Second Year (2025 Course) 3D Printing (3D Printing Processes: FDM, SAL, SLS, DMLS, Binder Jetting, etc.)			
Course Code	ILMDM202T-5	**Credit**	02
Contact Hours	**PR:** 02 Hrs./Weeks(P)	**Type of Course**	Theory
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

TOP

Pre-requisites: Computer Aided Design & Drafting Engineering Materials

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To introduce the fundamental concepts, evolution, and classifications of Additive Manufacturing (AM).
2	To understand major AM processes- FDM, SLA. Their parameters and industrial applications.
3	To understand major AM processes- SLS, DMLS, BJ. Their parameters and industrial applications.
4	To explore post-processing and applications of AM in various sectors.

Course Outcomes	
CO1	Explain the fundamentals and classifications of various Additive Manufacturing (AM) technologies.
CO2	Describe the working principles, capabilities, limitations, and applications of major AM processes like FDM and SLA.
CO3	Describe the working principles, capabilities, limitations, and applications of major AM processes like SLS, DMLS, and BJ.
CO4	Select appropriate AM technologies and materials for specific industrial and product applications.

Topics covered:

UNIT-I: Introduction to Additive Manufacturing (6 Hrs.)

Basics of Manufacturing: Conventional vs. Additive Manufacturing (AM).

Classification of AM Processes: ASTM F42 standard classification (Extrusion, Vat Photopolymerization, Powder Bed Fusion, Binder Jetting, etc.).

Workflow: Digital design, STL file generation, STL validation, slicing, printing, and post-processing.

UNIT-II: Material Extrusion & Vat Photo polymerization (6 Hrs.)

Fused Deposition Modeling (FDM/FFF): Principles, hardware components (nozzle, extruder, heating bed), materials (PLA, ABS, PETG, PEEK), and process parameters.

Stereolithography (SLA/DLP): Principles of photo-polymerization, photopolymers, laser/projector scanning mechanisms, and build speed optimization.

Process Comparison: Accuracy, speed, cost, and surface finish.

UNIT-III: Powder Bed Fusion & Material Jetting (6 Hrs.)

Selective Laser Sintering (SLS): Principles, CO2 laser, powder materials (Nylon 12, TPU), powder bed management, and advantages of self-supporting parts.

Metal Laser Sintering (MLS/DMLS/SLM): Principles of metal powder bed fusion, laser-matter interaction, and thermal management.

Binder Jetting (BJ): Principles, bonding agents, powder types (ceramics, metals, sand), and post-processing sintering.

UNIT-IV: Design for Additive Manufacturing (DfAM) & Post-Processin (6 Hrs.)

Design Rules: Part orientation, support structure generation (types, optimization), infill patterns, and wall thickness.

Optimization: Topology optimization, generative design, and lightweighting techniques.

Post-Processing: Support removal, surface finish improvement (sanding, polishing, chemical vapor smoothing), heat treatment, and curing.

Quality Control: Inspection methods, dimensional accuracy, and defect analysis.

UNIT-V: Industrial Applications & Future Trend (6 Hrs.)

Applications: Prototyping, tooling, aerospace, automotive, medical implants, and 3D bioprinting. **Case Studies:** Complex geometry manufacturing using SLS/DMLS.

Future Trends: 4D printing, multi-material AM, AI in 3D printing, and Industry 4.0 integration.

Text Books

1	Gibson, I., Rosen, D.W., and Stucker, B., Additive Manufacturing Technologies, Springer, 2021.
2	Chua, C.K., Leong, K.F., and Lim, C.S., Rapid Prototyping: Principles and Applications, World Scientific, 2020.
Reference Books	
1	Gebhardt, A., Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser, 2021.
2	Bandyopadhyay, A., and Bose, S., Additive Manufacturing, CRC Press, 2019.
3	Olaf Diegel, A Practical Guide to Design for Additive Manufacturing, Springer, 2019.
Reference Books	
1	https://www.coursera.org/learn/introduction-toadditive-manufacturing-processes
2	https://www.coursera.org/programs/iemuem-program-2024-2dvv9/learn/3dprinting-revolution?source=search
3	https://www.coursera.org/programs/iem-uem-program2024-2dvv9/specializations/3d-printing-additivemanufacturing?source=search

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	-	-	-	-	-	-	-
CO2	3	3	3	3	1	-	-	-	-	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-
CO4	2	1	2	2	-	-	-	-	-	-	-

Second Year (2025 Course) AI in Healthcare (AI Techniques (ML, DL, NLP, CV) in Diagnostics and Prognosis)			
Course Code	ILMDM202T-6	**Credit**	02
Contact Hours	**PR:** 02 Hrs./Weeks(P)	**Type of Course**	Theory
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

Pre-requisites:

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To understand the role of AI in modern healthcare systems.
2	To apply Machine Learning models for disease diagnosis and prognosis.
3	To implement Deep Learning models for medical image analysis.
4	To use NLP techniques for processing clinical text data.

Course Outcomes	
CO1	AI techniques used in healthcare applications
CO2	develop and evaluate AI models for diagnostic and prognostic healthcare problems.
CO3	Apply deep learning and NLP techniques to medical imaging and clinical text data.
CO4	Assess ethical, societal, and practical implications of AI implementation in healthcare systems.

Topics covered:	
UNIT-I:	**Introduction to AI in Healthcare** **(6 Hrs.)**
Overview of AI and its evolution in healthcare, Healthcare data types (EHR, medical images, wearable data), AI workflow in healthcare systems, Diagnostics vs Prognosis Applications: Disease detection, Clinical decision support, Drug	

discovery Challenges: Data privacy Bias and fairness, Explainable AI.
UNIT-II: Machine Learning Techniques & Prognosis (6 Hrs.)
Supervised Learning: Linear Regression, Logistic Regression, Decision Trees, Random Forest SVM Unsupervised Learning: K-Means, Hierarchical Clustering, PCA Model evaluation techniques:Confusion Matrix, Precision, Recall, F1-Score, ROC Curve Case studies: Heart disease prediction, Diabetes classification, Readmission prediction.
UNIT-III: Deep Learning for Medical Imaging (6 Hrs.)
Artificial Neural Networks, Backpropagation, Convolutional Neural Networks (CNN), Transfer Learning, Image Segmentation (U-Net concept), Applications: Tumor detection Pneumonia detection from X-ray, Skin cancer detection, Diabetic retinopathy detection
UNIT-IV: Explainable AI (XAI) & Ethics in Healthcare (6 Hrs.)
Text preprocessing techniques, Tokenization, Lemmatization, Named Entity Recognition (NER) Text classification, Word embeddings, Introduction to Transformers Applications: Clinical note analysis, EHR mining, Medical chatbot systems, Sentiment analysis.
UNIT-V Computer Vision & Prognosis Modelling (6 Hrs.)
Image preprocessing, Feature extraction, Object detection, Pattern recognition, Survival prediction models, Disease progression modelling, Risk scoring systems, Future trends in AI-driven personalized medicine

Text Books	
1	Kevin Murphy – Machine Learning: A Probabilistic Perspective
2	Ian Goodfellow – Deep Learning
3	Daniel Jurafsky – Speech and Language Processing
Reference Books	
1	"Machine Learning: A Probabilistic Perspective" – Kevin P. Murphy
2	Great for foundational ML concepts and algorithms.
3	"Deep Learning" – Ian Goodfellow, Yoshua Bengio & Aaron Courville
4	Comprehensive coverage of deep neural networks and DL techniques.
5	"Speech and Language Processing" – Daniel Jurafsky & James H. Martin
E- Books	

1	https://opentechbook.com/book/artificial-intelligence-and-machine-learning-in-health-care-and-medical-sciences/
2	https://www.mdpi.com/books/reprint/5268-artificial-intelligence-ai-and-machine-learning-ml-in-human-health-and-healthcare
3	https://doi.org/10.3390/books978-3-0365-4424-3

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-		2	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-
CO3	2	3	2	3	3	-	-	-	-	1	-
CO4	1	2	-	1	-	3	2	3	-	1	1

Second Year (2025 Course) Embedded System (Introduction to Embedded Processors)			
Course Code	ILMDM202T-7	**Credit**	02
Contact Hours	**PR:** 02 Hrs./Weeks(P)	**Type of Course**	Theory
Examination Scheme	**CCE:** 50 Marks **SEE:** 50 Marks	**Total Marks**	100

TOP

Pre-requisites: Digital Electronics, Computer Organization & Architecture, Microprocessors & Microcontrollers Basics

Course assessment methods/tools:

Sr. No.	Course assessment methods/ tools	External/ Internal	Marks
1.	Comprehensive Continuous Evaluation	Internal	50*
2.	Semester End Evaluation	Internal	50#

Course Objectives	
1	To understand the fundamentals of embedded systems and embedded processors.
2	To study architecture, features, and programming model of modern embedded processors.
3	To analyze ARM processor architecture, instruction set, memory, and I/O interfacing mechanisms.
4	To introduce real-time constraints and evaluate processor selection for embedded applications.

Course Outcomes	
CO1	**Understand** embedded system fundamentals and processor classifications.
CO2	**Explain** architecture and programming model of embedded processors.
CO3	**Analyze** ARM processor architecture, instruction sets, and interfacing mechanisms.
CO4	**Evaluate** embedded processor selection for real-time embedded applications.

Topics covered:

UNIT-I: Introduction To Embedded Systems And Processors (6 Hrs.)
Introduction to Embedded Systems, Characteristics of Embedded Systems, Embedded System vs General Purpose System, Components of Embedded System. Classification of Embedded Systems (Small, Medium, Sophisticated), Overview of Embedded Processors, Microprocessor vs Microcontroller.Overview of Embedded Processor Families: Intel 8086,ARM Holdings ARM,Texas Instruments DSP processors.
UNIT-II: Embedded Processor Architecture (6 Hrs.)
Processor Architecture Overview, Von-Neumann and Harvard Architecture, Modified Harvard Architecture. RISC vs CISC Architecture. Pipeline Architecture, Registers, ALU, Control Unit. Overview of ARM Architecture: ARM7 architecture features, Register organization, CPSR & SPSR, Exception handling. Introduction to Instruction Set Architecture (ISA).
UNIT-III: ARM Processor Programming Model (6 Hrs.)
ARM Processor Modes, Register Organization, Data Types and Memory Organization. ARM Instruction Set: Data Processing Instructions, Branch Instructions, Load/Store Instructions. Introduction to ARM Cortex-M3 architecture. Thumb Instruction Set, Interrupt Handling in ARM. Basic Assembly Programming Concepts
UNIT-IV: Memory And I/O Interfacing (6 Hrs.)
Memory Types: RAM, ROM, Flash Memory. Memory Interfacing Techniques. Addressing Modes in Embedded Processors. I/O Interfacing Concepts: Parallel and Serial Communication. Overview of Communication Protocols: UART, SPI, I2C. Introduction to Embedded Bus Architecture
UNIT-V: Real-Time Embedded Processors And Application (6 Hrs.)
Real-Time Systems: Hard and Soft Real-Time Systems. Interrupts and Polling Mechanisms. Watchdog Timer. Overview of Embedded Operating Systems. Introduction to Free RTOS. Applications of Embedded Processors in: Automotive Systems, Consumer Electronics, Industrial Automation, IoT Devices. Case Study of ARM-based Embedded System Design.

Text Books	
1	Embedded Systems: Architecture, Programming and Design – Raj Kamal, McGraw Hill.
2	ARM System Developer's Guide – Andrew Sloss, Dominic Symes, Chris Wright, Morgan Kaufmann.
3	Embedded Systems Design – Steve Heath, Newnes Publication.
Reference Books	
1	The Definitive Guide to ARM Cortex-M3 – Joseph Yiu, Newnes.
2	Embedded Systems: Introduction to ARM Cortex-M Microcontrollers – Jonathan W. Valvano.
3	Computer Organization and Design – Patterson & Hennessy

CO-PO Mapping Table:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	-	-	-	-	-	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	3	2	3	3	3	-	-	1	-	-	-