Sr. No	MDM Title	Faculty Lead	Active from
1	MDM in Communication System and Networks	Mrs. D. R. Chavan	AY 25-26
2	MDM in Semiconductor Technology	Mr. S. K. Parchandekar	AY 25-26
3	MDM in VLSI Design	Mr. R. G. Mevekari	- -
4	MDM in Embedded Systems & RTOS	Dr. S. V. Vanmore	- -
5	MDM in Geomatics Engineering	Dr. R. R. Rathod	- -
6	MDM in Art and Technology	Dr. R. R. Rathod	- -
7	MDM in Cloud Infrastructure & Automation	Mr. M. G. Rathi	- -
8	MDM in Cyber security and Digital Forensics	Mr. M. K. Chavan (CSE)	AY 25-26
9	MDM in AIML	Ms. A. B. Patil	AY 24-25
10	MDM in AgriTech	Ms. A. B. Patil	AY 25-26
11	MDM in Sustainability	Dr. Mrs. A. S. Karvekar	AY 25-26
12	MDM in Industry 4.0	Dr. K.H. Inamdar	AY 25-26
13	MDM in Industrial Engineering and Operations Research	Dr. S.U. Sapkal	- -
14	MDM in Construction and Project Management	Mr. A. A. Magdum	- -
15	MDM in Systems Engineering	Shri. N. V. Marathe	AY 25-26
16	MDM in Quantum Technology	Mr. M. B. Narnaware	- -
17	MDM in Innovation and Entrepreneurship Development	Dr. A. P. Patil	AY 25-26
18	MDM in Smart Cities	Dr. Deshbhushan Patil	AY 24-25
19	MDM in EV	Dr. Sushil S. Karvekar	AY 24-25
20	MDM in Fintech	Mr. Abhinandan B Admuthe	AY 24-25
21	MDM in Robotics and Automation	Dr. S. N. Ankalkhope	AY 24-25
22	MDM in Electronics Engineering	Mrs. N. S. Babar	- -
23	MDM in Information Technology	Dr. S. S. Solapure	- -
24	MDM in Mechanical Engineering	Mr. R.M. Chanmanwar	- -
25	MDM in Civil Engineering	Mr. S. G. Rathod	- -
26	MDM in Computer Science and Engineering	Mr. S. D. Pujari	- -

1. MDM in Communication System and Networks

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD251	IV	Fundamentals of Digital Communication and Networking	2	0	1	0	3
2	7MD311	V	IoT, Cloud and Edge Communication Protocols	2	0	1	0	3
3	7MD351	VI	5G Systems	2	0	1	0	3
4	7MD401	VII/VIII	Embedded Systems Integration with 5G	2	0	0	2	3
5	7MD451	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**3**	**6**	**14**

2. MDM in Semiconductor Technology

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD252	IV	Solid State Electronic Devices	2	0	1	0	3
2	7MD312	V	Semiconductor Material and Device Characterization	2	0	1	0	3
3	7MD352	VI	Semiconductor Nanofabrication	2	0	1	0	3
4	7MD402	VII/VIII	Microelectromechanical Systems	2	0	1	0	3
5	7MD452	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**4**	**4**	**14**

3. MDM in VLSI Design

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD253	IV	Introduction to Verilog Programming	2	0	0	2	3
2	7MD313	V	Verilog based System Design	2	0	1	0	3
3	7MD353	VI	Digital System Architecture	2	0	1	0	3
4	7MD403	VII/VIII	Testing and Verification of VLSI Circuits	2	0	1	0	3
5	7MD453	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**3**	**6**	**14**

4. MDM in Embedded Systems & RTOS

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD254	IV	Digital Systems and Microprocessors	2	0	1	0	3
2	7MD314	V	Microcontroller Based Systems	2	0	0	2	3
3	7MD354	VI	Embedded System Design	2	0	0	2	3
4	7MD404	VII/VIII	Real Time Operating Systems	2	0	1	0	3
5	7MD454	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**2**	**8**	**14**

5. MDM in Geomatics Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD255	IV	Surveying and Mapping	2	0	1	0	3
2	7MD315	V	Digital Image Processing and Remote Sensing	2	0	0	2	3
3	7MD355	VI	Geographic Information System	2	0	0	2	3
4	7MD405	VII/VIII	Geospatial Data Analytics and Applications	2	0	1	0	3
5	7MD455	VII/VIII	Mini project	0	0	0	4	2
			Total	**8**	**0**	**2**	**8**	**14**

6. MDM in Art and Technology

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD256	IV	Principles of Drawing and Sketching	2	0	0	2	3
2	7MD316	V	History of Indian Art	2	0	1	0	3
3	7MD356	VI	2D Animation and multimedia techniques	2	0	1	0	3
4	7MD406	VII/VIII	3D Product design development	2	0	0	2	3
5	7MD456	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**2**	**8**	**14**

7. MDM in Cloud Infrastructure & Automation

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD257	IV	Cloud Network & Fundamentals	2	0	1	0	3
2	7MD317	V	Virtualization Technologies	2	0	0	2	3
3	7MD357	VI	Cloud Computing Systems	2	0	1	0	3
4	7MD407	VII/VIII	Enterprise Cloud Platforms: AWS & Azure	2	0	0	2	3
5	7MD457	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**2**	**8**	**14**

8. MDM in Cyber security and Digital Forensics

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD258	IV	Cybersecurity Essentials	2	0	1	0	3
2	7MD318	V	Digital Forensics & Incident Response	2	0	1	0	3
3	7MD358	VI	Advanced Cyber Threats & Defence	2	0	0	2	3
4	7MD408	VII/VIII	Cybersecurity Policy, Governance & Ethics	2	0	1	0	3
5	7MD458	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	3	6	**14**

9. MDM in AIML

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD259	IV	Essentials of AI	2	0	1	0	3
2	7MD319	V	Searches and Logic in AI	2	0	1	0	3
3	7MD359	VI	Machine Learning using Python	2	0	0	2	3
4	7MD409	VII/VIII	Deep learning and Generative AI	2	0	1	0	3
5	7MD459	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	3	6	**14**

10. MDM in AgriTech

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD260	IV	Precision Agriculture	2	0	1	0	3
2	7MD320	V	Mechanization in Agriculture	2	0	1	0	3
3	7MD360	VI	Post-harvest Management	2	0	1	0	3
4	7MD410	VII/VIII	AI-Enabled Agriculture	2	0	0	2	3
5	7MD460	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	3	6	**14**

11. MDM in Sustainability

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD261	IV	Sustainable Energy Transition in India	2	0	1	0	3
2	7MD321	V	Sustainable Electronics	2	0	1	0	3
3	7MD361	VI	Design Thinking for Sustainability	2	0	1	0	3
4	7MD411	VII/VIII	Green Computing	2	0	1	0	3
5	7MD461	VII/VIII	Mini Project in Sustainability	0	0	0	4	2
			Total	8	0	4	4	**14**

12. MDM in Industry 4.0

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD262	IV	Cyber-Physical Manufacturing	2	0	1	0	3
2	7MD322	V	Digital Twin and Robotics	2	0	1	0	3
3	7MD362	VI	Next-Gen Manufacturing	2	0	1	0	3
4	7MD412	VII/VIII	Reliability and Industrial Automation	2	0	1	0	3
5	7MD462	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	4	4	**14**

13. MDM in Industrial Engineering and Operations Research

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD263	IV	Introduction to Industrial Engineering	2	0	1	0	3
2	7MD323	V	Operations Research Methods	2	0	1	0	3
3	7MD363	VI	Quality Control and Reliability	2	0	1	0	3
4	7MD413	VII/VIII	Inventory and Supply Chain Management	2	0	1	0	3
5	7MD463	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	4	4	**14**

14. MDM in Construction and Project Management

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD264	IV	Project Management for Infrastructure Development	2	0	1	0	3
2	7MD324	V	Human Resource and Labour Management	2	0	1	0	3
3	7MD364	VI	Occupational Health and Safety Management	2	0	1	0	3
4	7MD414	VII/VIII	Finance and Contract Management	2	0	1	0	3
5	7MD464	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	4	4	**14**

15. MDM in Systems Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD265	IV	Data Interpretation and Analysis	2	0	1	0	3
2	7MD325	V	Fundamentals of System Engineering and Architecture	2	0	1	0	3
3	7MD365	VI	System Dynamics	2	0	1	0	3
4	7MD415	VII/VIII	Digital Twin Techniques	2	0	1	0	3
5	7MD465	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	4	4	**14**

16. MDM in Quantum Technology

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD266	IV	Foundations of Quantum Computing	2	0	1	0	3
2	7MD326	V	Quantum Algorithms	2	0	0	2	3
3	7MD366	VI	Quantum Hardware, Error & Noise Mitigation	2	0	1	0	3
4	7MD416	VII/VIII	Advances in Quantum Technology	2	0	1	0	3
5	7MD466	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	3	6	**14**

17. MDM in Innovation and Entrepreneurship Development

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD267	IV	Fundamentals of Innovation and Entrepreneurship	2	0	1	0	3
2	7MD327	V	Ideation to Prototyping – Designing for Success	2	0	1	0	3
3	7MD367	VI	Defining Your Business Strategy	2	0	1	0	3
4	7MD417	VII/VIII	Business Acceleration and Scaling	2	0	1	0	3
5	7MD467	VII/VIII	Creating your own Venture	0	0	0	4	2
			Total	8	0	4	4	**14**

18. MDM in Smart Cities

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD268	IV	Introduction to Urban Planning	2	0	1	0	3
2	7MD328	V	Smart Infrastructure	2	0	1	0	3
3	7MD368	VI	Data Science and Analytics for Smart Cities	2	0	1	0	3
4	7MD418	VII/VIII	Green Technology and sustainability	2	0	1	0	3
5	7MD468	VII/VIII	Mini project	0	0	0	4	2
			Total	8	0	4	4	**14**

19. MDM in EV

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD269	IV	Introduction to Electric Vehicles	2	0	1	0	3
2	7MD329	V	Drives and Control for Electric Vehicles	2	0	1	0	3
3	7MD369	VI	Embedded Systems for Automotive Applications	2	0	0	2	3
4	7MD419	VII/VIII	Intelligent EV Ecosystems	2	0	1	0	3
5	7MD469	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	3	6	**14**

20. MDM in Fintech

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD270	IV	Introduction to Financial Markets	2	0	1	0	3
2	7MD330	V	Risk Management and Compliance	2	0	1	0	3
3	7MD370	VI	Financial Modelling	2	0	1	0	3
4	7MD420	VII/VIII	Data Science and analytics for FinTech	2	0	1	0	3
5	7MD470	VII/VIII	Mini Project	0	0	0	4	2
			Total					**14**

21. MDM in Robotics and Automation

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD271	IV	Fundamentals of Robotics and Automation	2	0	1	0	3
2	7MD331	V	Robot Kinematics and Dynamics	2	0	1	0	3
3	7MD371	VI	Computer Vision in Robotics	2	0	1	0	3
4	7MD421	VII/VIII	Control of Robotics Systems	2	0	1	0	3
5	7MD471	VII/VIII	Mini Project	0	0	0	4	2
			Total	8	0	4	4	**14**

22. MDM in Electronics Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD272	IV	Electronic Devices and Circuits	2	0	1	0	3
2	7MD332	V	Digital Systems	2	0	1	0	3
3	7MD372	VI	Microprocessors and Microcontrollers	2	0	0	2	3
4	7MD422	VII/VIII	Communication Engineering	2	0	1	0	3
5	7MD472	VII/VIII	Mini Project	0	0	0	4	2

Total	**8**	**0**	**3**	**6**	**14**

23. MDM in Information Technology

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD273	IV	Data Structure and Algorithm	2	0	0	2	3
2	7MD333	V	Operating System and Computer Networks	2	0	1	0	3
3	7MD373	VI	Database Engineering and Web Technology	2	0	0	2	3
4	7MD423	VII/VIII	Open Source Software Engineering	2	0	1	0	3
5	7MD473	VII/VIII	Mini-Project	0	0	0	4	2
			Total	**8**	**0**	**2**	**8**	**14**

24. MDM in Computer Science and Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD274	IV	Data Structure and Algorithm	2	0	0	2	3
2	7MD334	V	Software Engineering and Database Essentials	2	0	0	2	3
3	7MD374	VI	Professional Elective (Theory) AIML/Data Analytics/ Soft Computing	2	0	0	2	3
4	7MD424	VII/VIII	Networking and security	2	0	1	0	3
5	7MD474	VII/VIII	Mini-Project	0	0	0	4	2
			Total	8	0	3	6	**14**

25. MDM in Mechanical Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD275	IV	Elements of Mechanical Engineering	2	0	1	0	3
2	7MD335	V	Manufacturing Systems	2	0	1	0	3
3	7MD375	VI	Thermal Engineering	2	0	0	2	3
4	7MD425	VII/VIII	Industrial Engineering	2	0	1	0	3
5	7MD475	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**3**	**6**	**14**

26. MDM in Civil Engineering

S. N.	Code	Semester	Course Title	L	T	I	P	C
1	7MD276	IV	Modern Built Environment	2	0	1	0	3
2	7MD336	V	Urban planning	2	0	1	0	3
3	7MD376	VI	Sustainable construction	2	0	1	0	3
4	7MD426	VII/VIII	Civil Infrastructure Systems	2	0	1	0	3
5	7MD476	VII/VIII	Mini Project	0	0	0	4	2
			Total	**8**	**0**	**4**	**4**	**14**

27. Course Content for Semester IV

7MD251 Fundamentals of Digital Communication and Networking 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	Multidisciplinary Minor
Class, Semester	Second Year B. Tech., Sem.-II
Course Code	7MD251
Course Name	Fundamentals of Digital Communication and Networking
Desired Requisites:	Basic Electronics Engineering, Engineering Mathematics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To introduce the basic principles of signals, data transmission, and modulation.
2. To understand the foundations of digital communication and error control.
3. To learn OSI & TCP/IP models and key networking concepts.
4. To understand foundation for networking and security.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Understand the building blocks of digital communication systems, including sampling, quantization, modulation, and channel models.	Understand	II
CO2	Differentiate various digital modulation schemes and interpret error-control coding techniques used in digital communication.	Analyze	IV
CO3	Describe the OSI and TCP/IP communication layers along with the functions of each layer.	Understand	II
CO4	Analyze routing algorithms, addressing schemes, switching techniques, and end-to-end data transmission strategies.	Analyze	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3										
CO2	3	3			2						1
CO3	3										
CO4	3	3	2		2						

Module	Module Contents	Hours
I	**Communication Fundamentals** Basics of Analog and Digital signals, EM spectrum, bandwidth, channels, noise & distortion, SNR, attenuation, channel impairments, Sampling theorem, aliasing, quantization	4

II	**Digital Transmission Techniques** Pulse code modulation (PCM), DPCM, DM, Line coding: NRZ, RZ, Manchester, Bit rate vs baud rate, Error detection & correction: parity, checksum, CRC, Channel capacity: Shannon theorem	6
III	**Digital Modulation** ASK, FSK, PSK, QPSK, QAM (conceptual constellation), BER, noise effects, eye diagram, Multiplexing: TDM, FDM concepts	5
IV	**Computer Networking Basics** OSI 7-layer model, TCP/IP architecture, Transmission media: wired & wireless, Switching: circuit, packet, message switching	5
V	**IP Networks & Routing** IPv4 addressing, subnetting concepts, DHCP, DNS, NAT, Routing basics: static vs dynamic, Introduction to routers & switches	5
VI	**Internet Communication & Security** HTTP/HTTPS, FTP, SMTP, Basic cryptography concepts, Firewalls, IDS, IPS, Applications: WiFi, cellular systems, enterprise networks	5
		Total Hrs: 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz, Crossword etc. using online tools	Quiz using Google Forms, Kahoot, Mentimeter (covering Modules 1–2	**10**	**5**	**3**
	2	**Assignment** Problem-Solving / Short Assignment	Numerical problems on modulation, error control coding; worksheet on OSI layers	**10**	**5**	**5**
MSE	**3**	Case Study Presentation	Students present a case study on communication/networking	**15**	**10**	**7**
	4	Open Book Exam	Application-based questions on modulation, coding, and networking basics	**15**	**5**	**7**
ESE	**5**	Mini-Project	Small project: e.g., simulate a network, analyze BER	**20**	**15**	**10**
	6	Seminar	Students present a topic related to digital communication or	**15**	**10**	**11**

			networking (5G, IoT, routing, etc.)			
	7	Oral/Viva Exam	Viva on project + overall understanding	**15**	**10**	**13**
			Total	**100**	**60 hrs**	

Text Books	
1	Data Communications and Networking – Behrouz Forouza
2	Digital Communications – Simon Haykin
3	
4	
References	
1	Digital and Analog Communication Systems – Leon Couch
2	Computer Networks – Andrew S. Tanenbaum
3	Wireless Communications – Theodore Rappaport
Useful Links	
1	https://nptel.ac.in/
2	https://in.coursera.org/
3	

7MD252 Solid State Electronic Devices 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	Multidisciplinary Minor (Semiconductor Technology)
Class, Semester	Second Year B. Tech., Sem-II,
Course Code	7MD252
Course Name	Solid State Electronic Devices
Desired Requisites:	Engineering Physics, Basic Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Provides foundational knowledge of semiconductor materials and manufacturing processes essential for advanced device development.
2. Covers key semiconductor components and their operations, enabling students to design and analyze various electronic devices.
3. Introduces photonic devices and display technologies, essential for understanding modern optoelectronics and display systems.
4. Focuses on practical design and simulation skills, crucial for developing and testing semiconductor devices using advanced tools.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**Explain** the fundamentals of semiconductor materials, crystal growth processes, and industry trends.	Understand	II
CO2	**Explain** the working of basic and advanced semiconductor devices.	Understand	II
CO3	**Explain** the principles and applications of photonic devices and modern display technologies.	Understand	II
CO4	**Demonstrate** the simulation of various semiconductor devices using TCAD/Microwind tools.	Apply	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3										
CO2	3										
CO3	3										
CO4					2						

Module	Module Contents	Hours
I	**Fundamentals of Semiconductors and Crystal Growth** Basics of Semiconductors: Crystal Structure, Defects and Properties, Carrier Transport phenomena, Silicon Crystal Growth: Electronic Grade Silicon, Compound Semiconductor, Crystal Growth Methods, Wafer Manufacturing and Orientation.	**6**

II	**Junctions and Transistors** P-N junction, Metal-semiconductor junction, Tunnel diodes, Bipolar Junction Transistor, Heterojunction, MOS capacitor, Capacitance-Voltage characteristics, MOSFET, JEFET, Current-Voltage characteristics.	**6**
III	**Advanced Semiconductor Devices** Compound semiconductor devices (GaN, InGaAs, SiC) Advanced MOSFET, MOSFET Scaling, CMOS and BiCMOS, MESFET, MODFET, Microwave Diodes, Schottky Barrier Diode, Memory (NAND or Flash).	**6**
IV	**Photonic Devices and Display Technologies** LED, Photovoltaics, Photodetector, Phototransistors, Photomultiplier tube, CCD and CMOS sensors, CIS image sensor, LED-based display, understanding of RGB pixel technology, OLED and AMOLED displays, QLED, touch screen display	**6**
V	**Integrated Circuits** Evolution of Integrated Circuits, Monolithic device elements, Charge Transfer devices, Ultra Large-Scale Integration (ULSI), Testing, Bonding, and Packaging.	**3**
VI	**Design and Simulation of Semiconductor Devices** Design and simulation of PN junction, simulation of MOSFET, simulation of MOS capacitor, simulation of CMOS Gates and study its response, using TCAD/ Microwind or any other simulation software.	**3**
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Assignments**	Based on semiconductor materials, P-N junction, Transistors	**15**	**8**	**3**
	2	**Article Discussion**	Recent advancements in semiconductor devices, Moore's Law	**5**	**2**	**4**
MSE	**3**	**Short Quiz/ MCQ Test**	Basic and Advanced semiconductor materials and P-N junction and Transistors	**20**	**10**	**6**
	4	**Seminar**	Current design trends in semiconductor devices, new semiconductor devices	**10**	**5**	**8**
ESE	**5**	**Quiz/ MCQ Test**	Optoelectronic devices, display technologies, and Integrated Circuits	**30**	**20**	**12**
	6	**Mini Project**	Simulation of semiconductor devices	**10**	**10**	**13**
	7	**Oral/ Viva Exam**	All modules and to evaluate the understanding of solid-state electronic devices	**10**	**5**	**14**
			Total	**100**	**60 hrs**	

Text Books

1	B.G. Streetman, S. K. Banerjee, "Solid State Electronic Devices ", 7th Edition, Pearson India Education Service Pvt. Ltd., 2017.

2	Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 3rd Edition, McGraw Hill Higher Education, 2003.
3	K. Abbas, "Handbook of Digital CMOS Technology, Circuits, and Systems", "Springer", 1st Edition., 2020.
4	
References	
1	S. M. Sze and M. K. Lee, "Semiconductor Devices: Physics and Technology", 3rd Edition., John Wiley & Sons Inc., 2012.
2	Peter Y. Yu and M. Cardona, "Fundamentals of Semiconductors: Physics and Materials Properties", "Springer-Verlag Berlin", 4th Edition., 2010.
3	Robert L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", "Pearson Education", 11th Edition., 2014.
Useful Links	
1	https://nptel.ac.in/courses/108107142/
2	https://nptel.ac.in/courses/108106181/
3	https://www.youtube.com/playlist?list=PLF178600D851B098F
4	https://www.youtube.com/playlist?list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP

7MD253 Introduction to Verilog Programming 2 0 0 2 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in VLSI Design
Class, Semester	SY B.Tech Sem-IV
Course Code	7MD253
Course Name	Introduction to Verilog Programming
Desired Requisites:	Digital Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. To know the HDL language for Digital Design
2. To understand the difference in HDL and other high level programming language
3. To understand the concept in simulation and synthesis

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Model combinational and sequential components by developing synthesizable and optimized (for delay) HDL code.	Model	3rd
CO2	Analyze the given HDL code to generate synthesized RTL	Analyze	4th
CO3	Able to develop designed circuit using Verilog	Apply	3rd
CO4	Able to implement the using EDA tools	Analyse	4th

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2										
CO2	2	2									
CO3	2				3						
CO4	2	2			3						3

Module	**Module Contents**	**Hours**
I	**Combinational Circuit**: Review of K-Map, Adders, Subtractors, Mux, Demux, Design using Mux-Demux, Code Converters, Priority encoders	8
II	**Sequential Circuit:** Review of flip-flop, Asynchronous counters, Updown counters Synchronous Counters, Shift Registers, State Diagrams.	8
III	**Verilog:** Design Flow, Modules, Data types, Operators,	4
IV	**Modelling:** Types, Gate-Level modelling, Data Flow modelling ,Behavioral modelling, Switch Level Modelling.	4
V	**Tasks &Functions**: Tasks declaration, function declaration, types of functions	4
VI	**EDA tools:** Study of EDA tool, Implementation of Verilog code using EDA tools,	2
		Total Hrs : 30

List of Laboratory Experiments/ Practicals (if applicable)

1. Introduction to EDA tool with sample experiment in Verilog
2. full adder using half adder as a component
3. Four-bit full adder using 1-bit full adder as a component.
4. Full adder using 8:1 multiplexer as component
5. Full adder using 1:8 demux as component
6. Implementation of 4:1 mux using 2:1 mux as a component
7. Implementation of demultiplexer IC 74138
8. 4-bit comparator
9. Implementation of flip flops
10. Four-bit Counter using D-f/f
11. Counter using operators
12. UP counter and DOWN counter
13. Shift registers
14. Universal Shift register
15. Download procedure using EDA on Spartan Kits

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment	Based on Digital Design	10	**8**	
	2	Oral	Based on Digital Design & Verilog	10	**2**	
MSE	**3**	Test-1	Based on Digital Design	15	**10**	
	4	Oral	Based on Verilog	15	**5**	
ESE	**5**	Assignment	Based on Verilog modules	10	**20**	
	6	Oral	Based on Digital Design & Verilog	20	**10**	
	7	Skill test	Based on Lab experiments	20	**5**	
			Total	**100**	**60 hrs**	

Text Books

1	Anand Kumar, "*Fundamentals of Digital Circuits*", PHI
2	Mandal S.K , "*Digital Electronics*" 1st Ediction.Mc-Graw-Hill
3	Samir Palnitkar," Verilog HDL" Pearson

References

1	John F. Wakerly, *"Digital Design",* Pearson Education Publication
2	Douglas Perry , *"VHDL-Programming by Example"* TMH
3	Stephen Brown " Digital Design with Verilog Design" Mc-Graw-Hill

Useful Links

1	https://nptel.ac.in/courses/106103358 Digital System Design
2	https://nptel.ac.in/courses/108103179 Digital IC Design

List of suggested formative assessment methods

1. Simulation
2. Quiz
3. Report on Lab
4. Assignments
5. Oral/Viva Exam

7MD254 Digital Systems and Microprocessors 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Embedded Systems & RTOS
Class, Semester	SY B.Tech Sem-IV
Course Code	7MD254
Course Name	Digital Systems and Microprocessors
Desired Requisites:	Digital Electronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Understand the fundamental principle of digital circuits and understand the usage of microprocessors
2. Understand the architecture and features of microprocessors and microcontrollers.
3. To interface of real-world peripheral devices with microprocessors.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the fundamental principles of Sequential digital circuits.	Construct	I
CO2	Compare and describe the fundamental concepts of modern embedded microprocessor systems.	Compare	II
CO3	Interface microprocessor with peripheral devices.	Understand	II
CO4	Develop interfacing models according to applications using microcontrollers.	Apply	II

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2									
CO2		2									
CO3		3			3						
CO4			3								

Module	Module Contents	Hours
I	**Sequential Logic Design:** Introduction to sequential logic, Level-sensitive latches, Edge-sensitive flip-flops, synchronous and asynchronous circuits, Registers and shift registers, Counters, Algorithmic State Machine (ASM) design, Moore and Mealy machines.	5
II	**D/A converter and A/D Converter** Ladder type A/D converter, Dual slope A/D converter, Successive approximation A/D converter study of DAC 0800 and Study of ADC 0809 Chips.	5

III	**Introduction to Microprocessors:** 8085/86 microprocessors: Salient Features, Pin Description, Architecture of 8085/86: Functional Block Diagram, Microprocessor vs Microcontroller. 8085/86 Hardware description, memory Segmentation, Instruction set, addressing modes.	7
IV	**Interfacing devices:** Assembly Language Programming, interfacing with programmable peripheral devices System structure, I/O interfacing and Timing diagram IN and OUT instructions and Peripheral Interfacing, interfacing with LED, Memory mapped I/O.	7
V	**Interrupts:** 8085/86 interrupts and its classification, Software interrupts, priorities of interrupts, 8155and 8255 control register and its modes & Sample programs, Case study and Its applications.	6
		Total Hrs : 30

List of Laboratory Experiments/ Practical's

1. Functional tables of (i) JK Edge triggered Flip–Flop (ii) JK Master Slav Flip–Flop (iii) D Flip-Flop
2. 4-bit Universal Shift Register.
3. MOD-8 ripple counter using T-Flip-Flops.
4. BCD Adder Circuit.
5. To study the architecture of microprocessor 8085 & 8086 and familiarization with their hardware, commands & operation of microprocessor kit.
6. Assembly language programs.
7. Write a program to interface ADC & DAC with 8085.
8. Write a different program on interfacing with devices.

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Assignments**	Topics on digital logic vs. microprocessor systems	**20**	**6**	**3**
MSE	**2**	**Short Quiz / MCQ Test**	On sequential logic and ADC/DAC concepts	**20**	**10**	**6**
	3	**Seminar**	On emerging trends in microprocessor technology	**10**	**5**	**8**
ESE	**4**	**Long Quiz / MCQ Test**	On Microprocessor , hardware structure ,peripherals	**30**	**20**	**12**
	5	**Mini-Project**	Design and simulate a microprocessor-based system	**10**	**10**	**13**
	6	**Oral/Viva Exam**	On course topics and practical implementations	**10**	**5**	**14**
	8					
			Total	**100**	**60 hrs**	

Text Books

1	M. Morris. Mano, Digital Design, 5th Edition, Pearson, ISBN: 9780132774208, 2013
2	T. L. Floyd and R. P. Jain, Digital Fundamentals, 10th Edition, Pearson, ISBN: 978-8131734483, 2017.

3	Kenneth J. Ayala, the 8086 Microprocessor: Programming and Interfacing The PC, 1st Edition, Delmar Publishers, ISBN: 9780314012425, 2007.
4	"Microprocessor Architecture, Programming and Applications with the 8085 " Ramesh Gaonkar, Penram 6th Edition.
References	
1	R. J. Tocci, N. S.Widmer, and G. L.Moss Digital Systems Principles and applications, 12th Edition, Pearson Prentice Hall Edition ISBN : 9780134220215, 2017.
2	K. Ray, K. M. Bhurchandi, Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw Hill, ISBN:007014022, 2007.
3	Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition.
4	A. N. Sloss, D. Symes, C. Wright, ARM System Developer's Guide,1st Edition, Morgan Kaufmann,ISBN:9781493303748, 2004.
Useful Links	
1	https://nptel.ac.in/
2	https://in.coursera.org/
3	https://www.nxp.com/

7MD255 Surveying and Mapping 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Geomatics Engineering
Class, Semester	Second Year
Course Code	7MD255
Course Name	Surveying and Mapping
Desired Requisites:	Engineering graphics, basic geometry and geography

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To learn land surveying methods and instruments used in civil engineering.
2. To understand the importance of maps in engineering projects and the principles of map preparation
3. To learn the concepts and applications of topographical mapping.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Identify and classify different types of maps and scales, and understand coordinate systems and map projections.	Understanding	I
CO2	Apply various land surveying techniques for engineering projects.	Applying	III
CO3	Utilize principles of aerial photogrammetry for terrain modelling.	Applying	III
CO4	Understand GPS functioning and its use in surveying and mapping	Understanding	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2		1		1		2	1	2		1
CO2	1	2	3	1					1		
CO3	1		2	2	1						1
CO4	1				2						

Module	Module Contents	Hours
I	**Principles of Land Surveying** Overview of survey levels and their classifications. Levelling methods: Differential levelling, reciprocal levelling, and precise levelling. Surveying instruments: Compass, Theodolite, Total Station, and Tachometer. Applications of surveying in infrastructure development.	3
II	**Advanced Surveying Techniques** Trigonometric levelling: Concepts and applications. Traversing: Methods, adjustments, and plotting. Triangulation and trilateration: Principles, computations, and applications.	4

III	**Coordinate systems** Cartesian and geographical map projections and their types: Conformal, equal-area, and equidistant. Map datum: Concepts of MSL (Mean Sea Level), Geoid, spheroid, and WGS-84. Importance of map datum in GIS and engineering applications. Systems and Map Projections	4
IV	**Introduction to Maps** Definition and significance of maps in engineering projects. Types of maps: Topographical maps, cadastral maps, thematic maps, engineering maps. Scales of maps: large scale, medium scale, small scale, and their applications. Plotting accuracy and precision in map-making. Map sheet numbering and standardization.	5
V	**Aerial Photogrammetry** Types of aerial photographs: Vertical, oblique, and panoramic. Flying height, scale, and their importance in photogrammetry. Relief displacement and its effects on map accuracy. Introduction to Digital Elevation Models (DEM). Applications of DEM in slope analysis and topographical mapping. Introduction to stereoscopy and creation of 3D models.	5
VI	**Global Positioning Systems** Introduction to GPS: GPS signal structure, GPS modernization, types of GPS receivers, time systems, pseudo-range measurements, GPS measurements. GPS errors and Biases: GPS ephemeris errors, Selective availability, satellite receiver, and clock error, multipath error, ionospheric error, tropospheric errors Applications: GPS for utilities industry, forestry and natural resources, precision farming.	5
		Total Hrs: 30

Tutorial

Tutorial 1: Principles of Land Surveying

a. Overview of survey levels and classifications
b. Levelling methods: Differential, reciprocal, and precise levelling

Tutorial 2: Levelling Methods

a. Differential levelling: Procedure and accuracy
b. Reciprocal levelling: Elimination of errors

Tutorial 3: Levelling Methods Applications of Surveying in Infrastructure Development

a. Road alignment and construction
b. Bridge and dam site selection

Tutorial 4: Advanced Surveying Techniques

a. Trigonometric levelling: Concepts and field applications
b. Traversing: Methods, plotting, and adjustments

Tutorial 5: Systems and Map Projections

a. Introduction to map projection systems
b. Importance of map datum in GIS and engineering

Tutorial 6: Introduction to Maps

a. Definition and significance of maps in engineering projects
b. Types of maps: Topographical, cadastral, thematic, engineering maps

Tutorial 7: Aerial Photogrammetry

a. Types of aerial photographs: Vertical, oblique, panoramic
b. Flying height, scale, and importance in photogrammetry

Tutorial 8: Global Positioning Systems (GPS)

a. GPS signal structure and modernization
b. Types of GPS receivers and their applications

Tutorial 9: Global Positioning Systems (GPS)

a. GPS errors and biases: Ephemeris, selective availability, multipath, ionospheric, tropospheric
b. Applications of GPS in utilities, forestry, and precision farming

Tutorial 10: Revision

Course Assessment Plan (*for total 60 learning hours*)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Group Discussion	Role of precise levelling and modern Total Station surveying in improving infrastructure development quality in India.	10	5	2
	2	Online Quiz/Crossword	Create and attempt an online quiz on: Types of map projections GPS error sources Trigonometric levelling principles	10	10	4
MSE	**3**	Case Study Presentation	Analyze a real infrastructure project (road/highway/irrigation) and present how surveying (levelling, traversing, triangulation) influenced planning and execution.	10	20	6
	4	Portfolio Preparation	Students must maintain a portfolio including: Traversing fieldwork records Levelling calculations Total Station plotting GPS coordinate logs	20	5	6
ESE	5	Concept Mapping	Create a concept map showing relationships among: Levelling – Traversing – Triangulation – Map Projections – GPS – DEM	20	5	12
	6	Article Discussion (Reflection)	Select a research article on Digital Elevation Models and write a reflection on its engineering applications.	10	5	13
	7	Assignment	Solve numerical problems on: ● Trigonometric levelling ● Bowditch adjustment in traversing ● Map projection error calculations	20	5	13

Total				**100**	**60 hrs**	

Text Books	
1	Bindra S. P., "A Course in Highway Engineering", Dhanpat Rai Publications, 5th Edition 2012.
2	Kang-tsung Chang, "Introduction to Geographic Information Systems", Tata McGrawHill, 4thEdition, 2007
3	Ian HeyWood, Sarah Cornelius and Steve Carver , "An Introduction to Geographical Information Systems" , Pearson Education, 2nd Edition, 2006
References	
1	Fundamentals of Global Positioning System Receivers: A Software Approach James Bao-Yen Tsui Copyright @ 2000 John Wiley & Sons, Inc.
2	B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Surveying Vol. 1, 2 & 3.
Useful Links	
1	https://ocw.mit.edu/courses/12-540-principles-of-the-global-positioning-system-spring-2012/
2	https://nptel.ac.in/courses/106105219

7MD256 Principles of Drawing and Sketching 2 0 0 2 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Art and Technology
Class, Semester	SY, Semester – 3
Course Code	7MD256
Course Name	Principles of Drawing and Sketching
Desired Requisites:	NA, Understanding and observation skill

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	20	50	100
Practical	2 Hr /week	**Credits: 3**			

Course Objectives

1. To impart understanding of the fundamental elements and principles of drawing and sketching.
2. To introduce the concept of figure–ground relationship in visual composition.
3. To develop the ability to apply visual elements in drawings and sketches.
4. To enhance technical skills in contour drawing, space, perspective, and proportion.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	To understand basic methods, techniques & tools of drawing.	Understand	2
CO2	To develop skill of using drawing and painting material.	Develop	3
CO3	To develop aesthetic sensibility and skill enhancement.	Develop	3
CO4	To create nature and surroundings in drawings and sketches.	Create	6

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2							1		
CO2	2	3	2	1	2				2		2
CO3	1	3		2				1	2	1	2
CO4	2	3	3		3						3

Module	**Module Contents**	**Hours**
I	**Principles of Drawing:** Seven Elements Point, line, shape & form, colour, tones, texture and space. Seven principles: Unity, harmony, balance, rhythm, emphasis, proportion and contrast; line quality, contour and continuous line drawing; Free hand drawings.	5
II	**Types of Drawing:** Pencil Sketching, Pencil Shading, Cartoon and Anime Drawing, Landscape Drawing, Concepts of Light and Shadow; Types: Paintings, Collage, Mosaic, Etching, Wall-Mural and Sculptures.	5

III	**Principles of Sketching:** Basic Sketching Skills Shapes and Objects Drawing, proportion, Measurement and structure, Expression and emotion, Aesthetic composition and grace, Shapes and Objects, Tone and shade.	5
IV	**Drawing and Sketching Aspects:** Design and landscape Drawing, Drawings in vertical, horizontal format in 2 and 3 Dimensions, perspective, eye level, fixed point of view, vanishing point, ratio-proportion. Origin and Development, Main features, Characteristics, Aesthetic parameters, Symbolic representation in artworks, Identification of style & technique, Understanding of emotions and moral values.	5
V	**Art Techniques and Skill Development:** Development of observation skills for accurate visual representation. Practice of shading and texture techniques such as hatching, cross-hatching and stippling. Introduction to composition principles: balance, focal point, Golden Mean and effective use of negative space.	5
VI	**Colours and Shades:** Still-life, landscape, anatomy, abstraction and stylization. Transparent and opaque techniques, Drawing and painting media: Brushes, Paper, Surface, Canvas and Hard-board, Colouring materials: Charcoal, Soft Pastels, Oil Pastels Crayons, Natural Colours, Earth colours Pencil, Water, Acrylic, Poster, Inks etc.	5
		Total Hrs : 30

List of Laboratory Experiments/ Practicals (if applicable)

1. Study of 2/3 different forms in pencil with light and shade from a fixed point of view.
2. Study of 2/3 geometrical forms of objects like cubes, cones, cylinders and spheres etc.
3. Draw sketches of/from different forms.
4. Exercises in pencil with light and shade and in full colour from (point of view).
5. Imaginative painting on subjects in colours with colour values.
6. Draw and paint the still-life of a group of objects.
7. Make use of line, tone and texture, exploiting the medium fully to realize composition.
8. Print your composition in multi-colours.
9. Drawing and colouring of figures and organize in attractive visual compositions.
10. Geometric designs, Poster Designing and logo drawings etc.

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Drawing and Sketching	1. Sketches & drawing to develop aesthetic judgement and sensibility. 2. Detailed Study of observation, reproduction and analysis. 3. Interpreting a variety of themes and unique ideas	10	10	3
	2	Case Study Presentations		10	10	5
MSE	3	Drawing, Sketching and shading		10	10	6
	4	Group Discussion on aspects of drawings and sketches		10	10	7
	5	Assignments: Critiques of the homework drawings		10	10	1-8
ESE	6	Drawing, Sketching and Colouring		15	15	9
	7	Concept design composition in colours		15	15	10
	8	Assignments: Critiques of the homework drawings		20	20	1-13

	Total	**100**	**60 hrs**	
Text Books				
1	Holmes V Catherine, “How to Draw Cool Stuff: Shading Techniques for Teachers and Students: A Shading Guide for Teachers and Students”, Library Tales Publishing, 2025, ISBN:979-8894410067			
2	Scott Maier, “See, Think, Draw: An Easy Guide to Realistic Drawing and Beyond”, 2022, Get Creative 6 Publisher. ISBN: 978-1684620401			
3	Felix Scheinberger,” Dare to Sketch: A Guide to Drawing on the Go Kindle Edition”, Watson-Guptill Publishers, 2017, ISBN: 978-0399579554			
References				
1	Deborah Rockman, “Drawing Essentials”, 2nd Edition, Oxford University Press, ISBN 978-0-19-975894-4, 2011			
2	Ernest Norling, “Perspective Made Easy (Dover Art Instruction)”, 2003, Dover Publications Inc. ISBN: 9780486404738			
Useful Links				
1	https://onlinecourses.nptel.ac.in/noc26_hs48/preview?utm			
2	https://onlinecourses.nptel.ac.in/noc26_mg51/preview?utm			

7MD257 Cloud Network & Fundamentals 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Cloud Infrastructure & Automation
Class, Semester	SY B.Tech , Semester IV
Course Code	7MD257
Course Name	Cloud Network & Fundamentals
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To Understand basics of computer networks & cloud infrastructure.
2. To explore network devices, addressing, routing & protocols.
3. To introduce cloud networking, VPC, IAM & security.
4. To build foundation for deploying cloud-ready networks.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Understand fundamental networking architectures.	Understanding	II
CO2	Apply IP addressing, sub-netting & routing concepts.	Applying	III
CO3	Analyze cloud networking models & access controls.	Analyzing	IV
CO4	Evaluate secure and scalable cloud network solutions.	Evaluating	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	1						1	1	
CO2	3		2	1					1	1	
CO3	2		3	2	2	1		1	2	2	
CO4	2	3		2	3		1	2	2	2	2

Module	**Module Contents**	**Hours**
I	**Computer Network Basics:** Network types: LAN, WAN, MAN, OSI Model, TCP/IP Stack, Network devices: Router, Switch, Access Point, IPv4 & IPv6 Basics	5
II	**IP Addressing & Routing:** IPv4 Addressing, Subnetting, CIDR, Static & Dynamic Routing, Routing Protocols: RIP, OSPF (basics), Switching, VLAN, Trunking	6
III	**Network Services & Security:** DNS, DHCP, NAT, Firewall, Network Access Control, Wireless security basics, Zero Trust fundamentals	4

IV	**Introduction to Cloud Networking:** IaaS, PaaS, SaaS, Cloud deployment: Public, Private, Hybrid, Virtual routers, subnets, cloud networks, VPN, Virtual Private Cloud (VPC)	5
V	**Cloud Connectivity & Access Control:** VPC Peering, Load Balancers, Security Groups, Network ACLs, Cloud DNS, CDN Basics, Identity & Access Management (IAM)	5
VI	**Cloud Infrastructure & Operations:** Monitoring & Logging, Reliability, Fault tolerance, Autoscaling, Cloud storage networking, Case Studies: AWS/Azure/GCP	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours*)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz / Crossword	Online quiz on Computer Network Basics & IP Addressing	10	6	Week 3
	2	Assignment	Assignment on Routing & Switching, VLAN,	10	6	Week 5
MSE	**3**	Case Study Presentation	Presentation on uses cases of DNS/DHCP/NAT/Firewall	20	12	Week 7
	4	Design of Experiment	Design a secure enterprise network architecture	10	6	Week 9
ESE	**5**	Prototype Making	VPC, Subnets, Security Groups & Load Balancer	20	12	Week 10
	6	Testing & Debugging Activity	Routing, DNS, auto-scaling / monitoring alerts	20	12	Week 12
	7	App/Website Making / Cloud Deployment	Deploy a small website/web-app on cloud,	10	6	Week 13
			Total	**100**	**60 hrs**	

Text Books

1	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *"Mastering cloud computing"*, Mc Graw Hill Education, 3rd Edition, 2013
2	Gary Lee,"*Cloud Networking: Understanding Cloud-based Data Center Networks"* , Morgan Kaufmann, 1st Edition, 2014

References

1	James F. Kurose, Keith W. Ross, *"Computer Networking: A Top-Down Approach"*, Pearson, 7th Edition, 2017
2	Thomas Erl, *"Cloud Computing: Concepts, Technology & Architecture"*, Pearson, 2013.

Useful Links

1	https://nptel.ac.in/courses/106105223
2	https://nptel.ac.in/courses/106105167

7MD 258 Cybersecurity Essentials 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Cyber Security & Digital Forensics
Class, Semester	SY B.Tech Semester IV
Course Code	7MD258
Course Name	Cybersecurity Essentials
Desired Requisites:	Basic knowledge of computer networks & operating systems

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hrs/week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To introduce fundamental concepts of cybersecurity, threats, vulnerabilities, and risks.
2. To develop understanding of key security mechanisms such as authentication, access control, cryptography, and network security.
3. To analyze common cyberattacks and understand their impact on systems and networks.
4. To build foundational skills for applying cybersecurity best practices in real-world scenarios.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Explain fundamental cybersecurity concepts, threats, and risks.	Understand	L2
CO2	Analyze different forms of cyberattacks and their impact	Analyze	L4
CO3	Evaluate essential security mechanisms such as authentication, access control, and cryptography.	Evaluate	L5
CO4	Recommend cybersecurity practices for securing systems and networks.	Create	L6

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	1	1	1						
CO2	2	3	2	2	2						
CO3	2	2	3	2	2						
CO4	1	2	3	2	3	1		1	2	1	

Module	**Module Contents**	**Hours**
I	**Introduction to Cybersecurity**: CIA triad, threat landscape, assets, vulnerabilities, exploits, risk management basics.	5
II	**Cyberattacks & Malware**: Phishing, ransomware, DoS/DDoS, brute force, SQL injection, malware behavior.	5

III	**Authentication & Access Control**: Password security, MFA, IAM, RBAC, privilege escalation.	5
IV	**Basics of Cryptography**: Symmetric/asymmetric encryption, hashing, digital certificates, SSL/TLS.	5
V	**Network Security Tools & Techniques**: Firewalls, IDS/IPS, VPN, Wi-Fi security, packet inspection.	5
VI	**Cyber Hygiene & Protection Measures**: Secure configurations, patching, backups, endpoint protection, incident reporting.	5
		Total Hrs : 30

List of Interaction Sessions

(Activities for ISE, formative assessments, demos…)

1. Case study: Real-world cyberattack analysis
2. Demonstration of phishing identification
3. Group discussion: Password policies vs usability
4. Risk assessment for a small organization
5. Debate: Privacy vs security
6. Short quiz using online tools
7. Open-book problem-solving activity
8. Concept mapping of cybersecurity ecosystem
9. Report on a popular security breach
10. Small cyber hygiene checklist creation

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz	Short-answer quiz on cybersecurity fundamentals	**10**	**6**	**3**
	2	Case Study Analysis	Analysis of a real cyberattack scenario with findings and recommendations	**10**	**6**	**6**
MSE	**3**	Design Challenge / Problem-Based Task	Students solve a cybersecurity problem (e.g., propose defense steps, identify vulnerabilities, or secure a small system) and present the solution	**30**	**15**	**7**
ESE	**5**	End-semester theory exam	written exam on core concepts	**40**	**25**	**13**
	6	Viva / Oral Assessment	oral evaluation on security practices and reasoning	**10**	**8**	**13**
				100	**60**	

Text Books	
1	William Stallings – *Network Security Essentials*
2	Mark Ciampa – *Security+ Guide to Network Security Fundamentals*
3	Chuck Easttom – *Computer Security Fundamentals*
4	Matt Bishop – *Computer Security: Art and Science*
References	
1	NIST SP 800-61 (Incident Handling)
2	NIST SP 800-53 (Security Controls)
3	Cisco CyberOps Associate Materials
Useful Links	
1	https://owasp.org
2	https://www.cisa.gov
3	https://www.cybrary.it

7MD259 Essentials of AI **2 0 1 0 3**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2025 - 26 (Revised)					
Course Information					
Programme	MDM in Artificial Intelligence and Machine Learning				
Class, Semester	SY B.Tech Semester IV				
Course Code	7MD259				
Course Name	Essentials of AI				
Desired Requisites:	Basic Computer Usage				

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To introduce search (A*) and CSPs for optimization problem formulation and solution implementation.
2. To teach First-Order Logic and Chaining for knowledge deduction.
3. To examine AI architectures and enable students to analyze and propose methods for diagnostics/control.
4. To familiarize students with AI deployment risks and develop evaluation skills for robust, ethical implementation.

Course Outcomes (CO

CO	Description	Blooms Taxonomy	
		Descriptor	**Level**
CO1	Formulate optimization problems using search or CSPs and implement A* to find efficient solutions.	**Applying**	III
CO2	Translate facts into First-Order Logic (FOL) and demonstrate inference (Chaining) to deduce new knowledge.	**Analyse**	IV
CO3	Analyse various AI system architectures and propose suitable approaches for tasks in diagnostics or control.	**Analyse**	IV
CO4	Evaluate the ethical concerns, safety, and hardware needs of deployed AI systems, and justify decisions for robust implementation.	**Analyse**	IV

CO and PO Mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**3**	**3**	1	**3**	1	-	-	-	-	-
CO2	**3**	**3**	1	**2**	-	-	-	-	-	-	-
CO3	**2**	**3**	**3**	1	**3**	**2**	-	-	-	-	-
CO4	1	**2**	**2**	-	-	**3**	**3**	-	-	-	**2**

Module	**Module Contents**	**Hours**

I	**Foundations of AI** Introduction to AI - Definitions, Scope, History and Evolution to AI, Conventional Computing vs AI Systems, Turing Test, Cognitive Modelling, Real-world AI Success Stories.	05
II	**Problem Solving** AI and Search Foundation, Problem Representation (Blind Search), Uninformed Search, Informed Search (Heuristic Search), Advanced Search, Constraint Satisfaction Problems, CSP Techniques.	05
III	**Knowledge and Reasoning** Architecture and Function, Formal Logic for Knowledge Representation, First-Order Logic (FOL) and Inference, Inference Mechanisms: Chaining, Reasoning and Uncertainty.	05
IV	**AI Language, and Diagnostics** Natural Language Processing (NLP) Overview, Speech Recognition and Machine Translation, Large Language Models (LLMs), Expert Systems and Rule-Based AI, Knowledge Representation, AI for Diagnostics.	05
V	**AI for Physical Systems and Control** AI in Robotics, Autonomous Navigation, Robotic Vehicles, Autonomous Planning and Scheduling, Optimization for Systems.	05
VI	**Ethical AI, Safety, and Practical Implementation** AI Ethics and Societal Impact, Safety and Robustness of AI, Deployment Workflow, Hardware of AI, Ethical and Legal Principles.	05
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	4	Online Quiz / Crossword	A quiz on AI Foundations / History.	10	10	3
	18	Design Challenge	Design a simple Knowledge Base using logic	10	10	Throughout Semester
MSE	4/23	Online Quiz / Crossword / Online Coding Challenge	Quiz: Rapid-fire assessment on AI History, Definitions, and Search terms. **Coding:** Implementation of a simple Uninformed Search algorithm	30	15	8
ESE	5/2	Case Study Presentation / Debating	Present and defend an analysis of AI Safety and Ethical Dilemmas	15	10	12
	33	Oral/Viva Exam	Comprehensive Viva on all modules, focusing on theoretical concepts	35	15	14-15
Total				100	60 hrs	15

Text Books

1	Russell, Stuart J., and Peter Norvig., ***Artificial Intelligence: A Modern Approach***, 4th ed., Pearson Education, 2020.
2	Elaine Rich, Kevin Knight and Nair, ***Artificial Intelligence***, TMH, ISBN-978-0-07-008770.
3	Poole, David, and Alan Mackworth, ***Artificial Intelligence: Foundations of Computational Agents***, 2nd ed., Cambridge University Press, 2017.
References	
1	Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep ***Learning***, 1st ed., MIT Press, 2016.
2	Nilsson, Nils J., ***Artificial Intelligence: A New Synthesis***, 1st ed., Morgan Kaufmann, 1998.
3	Latombe, Jean-Claude, ***Robot Motion Planning***, 1st ed., Kluwer Academic Publishers, 1991.
4	Kearns, Michael, and Aaron Roth, ***The Ethical Algorithm: The Science of Minimizing Harm and Maximizing Benefit***, 1st ed., Oxford University Press, 2019.
Useful Links	
1	https://nptel.ac.in/courses/106106226
2	https://nptel.ac.in/courses/106105152
3	https://nptel.ac.in/courses/129106748
4	https://nptel.ac.in/courses/106106472
5	https://nptel.ac.in/courses/109106184

7MD260 Precision Agriculture 2 0 1 0 3

	Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
	AY 2025-26					
	Course Information					
	Programme	MDM in AgriTech				
	Class, Semester	SY - B. Tech., Sem. IV				
	Course Code	7MD260				
	Course Name	Precision Agriculture				
	Desired Requisites:					

	Teaching Scheme		**Examination Scheme (Marks)**			
	Lecture	2Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
	Interaction	1Hrs/week				
	Tutorial	-	30	20	50	100
	Practical	-	**Credits: 3**			

	Course Objectives	
	1	To explain the evolution and benefits of precision agriculture by comparing traditional and modern farming techniques for efficiency, productivity, and sustainability.
	2	To apply IoT, sensor, and drone technologies to monitor crops, optimize irrigation, and manage soil health effectively.
	3	To utilize GPS and GIS tools to perform precision planting, mapping, and variable rate applications for resource optimization..
	4	To analyze and manage agricultural data to support informed decision-making, predictive analytics, and the design of integrated precision farming solutions.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

	CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
	CO 1	Understand the fundamentals of precision agriculture and its real-world applications	II	Understand
	CO 2	Analyze and interpret agricultural data to make informed decisions	III	Apply
	CO 3	Implement precision irrigation and fertilization techniques to optimize resource use	IV	Analyze
	CO 4	Develop skills to analyse and manage large agricultural datasets for precision-farming decisions	IV	Analyze

Programme Outcomes (PO)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**
	CO1	3	-	-	-	-	1	2	-	-	-	-
	CO2	2	2	-	-	-	-	-	-	-	-	-
	CO3	2	-	-	-	2	-	-	1	-	2	1
	CO4	2	1	2	2	-	2	1	-	1	-	-

	Module	**Module Contents**	**Hours**

	I	**Introduction to precision Agriculture** The Evolution of Agriculture: From Traditional to Precision, Key Components of Precision Agriculture, Benefits of Precision Agriculture: Efficiency, Productivity, Sustainability	5
	II	**IoT and Sensor Technology** Introduction to the Internet of Things (IoT) in Agriculture, Smart Irrigation Systems: Saving Water, Enhancing Yields, Soil Health Monitoring: Nutrient and Moisture Sensors	5
	III	**GPS and GIS in Agriculture** Basics of GPS Technology and Applications in Agriculture, Geographic Information Systems (GIS): Mapping and Analysis, Precision Planting and Variable Rate Technology (VRT)	5
	IV	**Remote Sensing and Drones** Remote Sensing Technologies: Types and Applications, Introduction to Agricultural Drones: Scouting, Mapping, and Spraying, Data Collection and Analysis from Drones, Legal and Ethical Considerations in Drone Use	5
	V	**Data Management and Analysis** Collecting and Storing Agricultural Data, Organizing and Cleaning Data, Data Analytics for Decision Making, Predictive Analytics, Future Precision Farming Technologies	5
	VI	**Integrated PA Case Studies and Application** Case Studies: VRT fertilization, Automated Irrigation system, Ethical and Economic Consideration, Future of Agritech	5
		Total	30

Assessment

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	4	Quiz, Crossword etc. using online tools	Continous Assesment, Knowledge Check, application of basics and analytical skill	10	10hrs	Throughout course
	28	Assignments		10	10hrs	Throughout course
MSE	29	Open Book Exam	Suitable for evaluating comprehension, analysis, synthesis, and evaluation rather than rote learning.	15	10hrs	Week 9
	1	Group Discussion	Content Relevance and Knowledge, Team Interaction and Collaboration	15	10Hrs	Week 10

ESE	2, 5	Case Study Presentations/ Debating	Analyzing a complex real-world PA implementation and presenting findings/arguments).	30	10 hrs	Weeks 12–13
	33	Oral/Viva Exam	(Assessing conceptual clarity, project knowledge, and communication skills).	20	10hrs	Week 14-15
			Total	**100**	**60 hrs**	**15**

Text Books	
1	Tulsa Ram, Precision Farming a New Approach, Daya Publishing House, 2014
2	K. R. Krishna, Precision Farming - Soil Fertility and Productivity Aspects, CRC press, 2013
3	Aniruddh Kumar, Indian Agriculture: Agrarian Crisis, Organic Farming, Conventional Farming and Precision Farming, Shandilya Publications, 2017
References	
1	Ancha Srinivasan, Handbook of Precision Agriculture Principles and Applications, CRC Press 2006
2	Terry A. Brase, Precision Agriculture, Thomson Delmar Learning, New York, USA. Published in 2006,
3	Qin Zhang, Precision Agriculture Technology for Crop Farming, CRC Press, 2015.
Useful Links	
1	https://nptel.ac.in/courses/126105810
2	https://nptel.ac.in/courses/126104002
3	https://nptel.ac.in/courses/126104005

7MD261 Sustainable Energy Transition in India 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech.
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	7MD261
Course Name	Sustainable Energy Transition in India
Desired Requisites:	Basic knowledge of energy systems, power generation, and sustainability.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To provide foundational knowledge of India's current energy system, its challenges, and the need for a sustainable transition.
2. To develop students' understanding of various renewable energy technologies and enhance their ability to apply these technologies in real-world Indian contexts.
3. To enable students to critically analyse national policies, missions, and regulatory frameworks that drive India's sustainable energy transition.
4. To equip students with the ability to evaluate clean energy implementation models, challenges, and global best practices for achieving long-term climate and sustainability targets.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Understand India exists energy system and the need for sustainable transition.	Understand	II
CO2	Explain renewable energy technologies and their deployment in India.	Apply	III
CO3	Analyze key government policies and programs accelerating energy transition.	Analyze	IV
CO4	Evaluate challenges and opportunities in achieving India's long-term climate goals.	Evaluate	V
CO5	Analyze and evaluate clean energy models, best practices, and emerging innovations considering technical, economic, and managerial aspects.	Analyze	VI

CO-PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	-	2	3	-	-		-
CO2	3	2			2	-	3	-	-		-
CO3	2	3	-	2	-	2	3	-	-	2	-
CO4	2	3	-	2	-	2	3	-	-	2	-
CO5	2	3	2	2		2	3	-		2	2

Module	Module Contents	Hours

I	**Introduction to Energy Systems in India** India's energy landscape: production, consumption, sector-wise distribution, Types of energy sources and classification, Environmental issues with coal & fossil fuels, Sustainable development goals (SDG-7), Need for decarbonization	6
II	**Renewable Energy Sources & Technologies** Solar: working principle, PV modules, advanced PV technologies, Wind: turbine design, variable-speed & offshore wind turbines, wind potential zones in India, small hydro: potential & limitations, run-of-river and micro-hydro technologies, Hybrid renewable systems, Solar-Wind hybrids, Solar-Storage systems	4
III	**Policies & Regulatory Framework** Planning, Renewable Purchase Obligation (RPO), Renewable Energy Certificate (REC) Mechanism, Green Open Access Rules, Open Electricity Market (Power Trading, Market-Based Tariff Mechanisms), and Institutional Regulatory Roles (Central & State Electricity Regulatory Commissions)	5
IV	**Renewable Energy Missions & Energy Efficiency Initiatives** National Solar Mission, National Wind Energy Mission, Green Hydrogen Mission, PM-KUSUM Energy Efficiency, Bureau Programs: UJALA PAT Scheme, STAR Labelling India's commitments under COP21, COP26	5
V	**Challenges & Future Pathways** Carbon emissions, Intermittency & need for storage Battery technologies, Smart grids & digitalization, Financial, technical & regulatory challenges, Role of EVs in energy transition, Net-zero pathway: India 2070 roadmap	5
VI	**Clean Energy Best Practices & Innovations** Gujarat RE model (solar rooftop success), Rajasthan large-scale RE projects, International best practices, Future innovations: EV ecosystem development: charging infrastructure and grid impact, Vehicle-to-grid (V2G) and managed charging strategies, green hydrogen production, storage, and utilization, Research, innovation, and industry-academia collaboration	5
		Total Hrs: 30

Course Assessment Plan (***for total 60 learning hours)***

T		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE 1	1	Digital Poster Making (or Sketching) and Presentation	Assess understanding of India's energy landscape (CO1, CO2) Students create a digital poster OR hand-drawn sketch on: • Energy transition • Renewable potential • Case study visualization Creativity (3), Technical clarity (4), Presentation (3)	**10**	**10 hours** (4 hrs research, 4 hrs designing, 2 hrs presentation)	Week 3–4
ISE 2		Quiz, Crossword etc. using online tools	Continuous assessment of Modules I–III (CO1, CO2, CO3) Google Forms quizzes, crossword puzzles, short-answer assignments Accuracy (5), Concept clarity (5)	**10**	**10 hours**	Week 5–6

MSE	2	Certification course of 10-12hr duration on platform like coursera /Udemy/NPTEL	Strengthen technical skills in renewable energy (CO2, CO3) NPTEL / Coursera / Udemy "Solar Energy Basics", "Wind Energy", "Energy Transition & Climate Policy" Certificate completion + short reflective summary	**30**	**14 hours**	Week 7–8
ESE	3	Community Engagement Project in chosen field	**Option A: Community Engagement Project (Recommended)** Students work in the field & prepare a report on: ● Solar rooftop survey ● Local energy consumption audit ● Awareness programs on energy saving ● EV charging mapping in the locality **Option B: Case Study Presentation** Deep-dive analysis of any model: ● Gujarat RE Model ● Delhi EV Policy ● Jaisalmer Wind Park ● International best practices (Germany/China/Denmark) Field activity / data collection (10 M) technical analysis (CO3, CO4, CO5) (20 M) Report writing (10 M) Viva / Presentation (10 M)	**50**	**26 hours**	Week 10–12
			Total	100	60 hrs	

Text Books	
1	Energy & Sustainability-K. Pereira, Oxford University Press
2	Renewable Energy Engineering-B. Khan
3	Sustainable Energy Planning in India-TERI Publications
References	
1	Solar Energy: Principles of Thermal Collection -Duffie & Beckman
2	Wind Energy Explained -Manwell, McGowan
3	MNRE official reports
4	IPCC & IEA energy transition reports
Useful Links	
1	https://nptel.ac.in/courses/108/101/108101156/
2	https://nptel.ac.in/courses/108/108/108108162/

7MD262 Cyber-Physical Manufacturing 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Industry 4.0
Class, Semester	SY B.Tech., IV
Course Code	7MD262
Course Name	Cyber Physical Manufacturing
Desired Requisites:	NA

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To develop fundamental understanding of smart manufacturing systems
2. To enable integration of digital manufacturing technologies
3. To equip with skills in industrial sensing and IIoT-based connectivity
4. To build competency in predictive maintenance and smart logistics automation

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	To understand, the evolution of manufacturing systems and the role of cyber-physical systems in smart factories	I	Understanding
CO2	To identify, digital manufacturing systems such as CNC, FMS, and real-time production monitoring using OEE and MRP	II	Identifying
CO3	To select industrial sensors and IIoT platforms for machine connectivity, condition monitoring, and data acquisition	III	Developing
CO4	To analyse equipment health, implement predictive maintenance strategies, and understand smart material handling systems using AGVs and automated logistics.	II, IV	Understanding , Analysing

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2										
CO2		2			2						
CO3		2	2								
CO4			2	2	2	3					

Module	**Module Contents**	**Hours**
I	**Fundamentals of Smart Manufacturing** Evolution from Industry 1.0 → 4.0, Manufacturing systems overview, Cyber-physical systems (CPS) basics, Production equipment in digital factories	5

II	**Digital Manufacturing Systems** CNC, machining centres, FMS and their digital integration, Material resource planning, Real-time machine utilization & OEE	5
III	**Sensors for Industrial Systems** Vibration, acoustic, thermal & force sensors, Condition monitoring, Integration with IoT platforms	5
IV	**Connected Machines & Equipment Monitoring** IIoT for machines, Digital retrofitting of old equipment, PLC–machine interfacing basics	5
V	**Predictive Maintenance** Failure modes in rotating machinery, Diagnostics using sensor data, Case studies from pumps, motors, HVAC, compressors	5
VI	**Smart Material Handling & Logistics Automation** AGVs & AMRs for material movement, Conveyor & transfer systems, Digital warehouse management	5
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Group Discussion	On module I, II and III	10	5I + 5SL	Week 3
	2	Group Presentations	On Module IV, V and VI	10	5I + 5SL	Week 10
MSE	**3**	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module I-III	15	10 SL	Week 8
	4	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module IV-VI	15	10 SL	Week 15
ESE	**5**	Exam Online (Preferred) / Offline	40% weightage on modules I to III and 60% weightage on modules IV to VI.	50	20 SL	Week 16
			Total	**100**	**60 hrs**	

Text Books

1	**Groover, M. P. (2020).** *Automation, production systems, and computer-integrated manufacturing* (5th ed.). Pearson.
2	**Gilchrist, A. (2016).** *Industry 4.0: The industrial internet of things*. Apress.
3	**Bokrantz, J., Skoogh, A., & Skoogh, A. (2021).** *Predictive maintenance in smart factories*. Springer.

References

1	Kaur, G., Dhillon, J. S., Rani, G., & Elngar, A. (2024). Intelligent manufacturing: Exploring AI, blockchain, and smart technologies in Industry 4.0. Routledge.
2	**Jeschke, S., Brecher, C., Song, H., & Rawat, D. B. (Eds.). (2017).** *Industrial internet of things: Cybermanufacturing systems*. Springer.
3	

Useful Links

1	https://www.sciencedirect.com/science/article/pii/S2667344423000099

2	https://www.iiot-world.com/smart-manufacturing/discrete-manufacturing/digital-twins-in-cnc/
3	https://www.siemens.com/global/en/products/automation/systems/cnc-sinumerik/automation-systems/sinumerik-one/digital-twin.html
4	https://www.fanucamerica.com/products/cnc/cnc-software/smart-digital-twin-for-manufacturing
5	https://nraoiekc.blogspot.com/2020/11/digital-twins-of-cnc-machines.html
6	https://www.mdpi.com/2504-4494/9/7/211

7MD263 Introduction to Industrial Engineering 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech.
Class, Semester	S.Y. B.Tech. - IV
Course Code	7MD263
Course Name	Introduction to Industrial Engineering
Desired Requisites:	NA

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Understand the history of Industrial Engineering (IE), define productivity concepts, and identify IE applications in various sectors.
2. Implement method study techniques using process charts, flow diagrams, and motion economy principles to improve efficiency.
3. Conduct work measurement studies via time study, PMTS, and work sampling to establish performance standards.
4. Analyze ergonomics for optimal workplace design, evaluate facility layouts, and solve engineering economics problems involving replacement and queuing theories.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Define/describe the basic productivity concepts, productivity measurement approaches, replacement theory.	Remembering	I
CO2	Explain work measurement, method study techniques, facility planning.	Understanding	II
CO3	Apply work study techniques, replacement and queuing theory.	Applying	III
CO4	Analyse ergonomics, work design, facility planning.	Analysing	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2										
CO2		2									
CO3			2								
CO4				2							

Module	Module Contents	Hours
I	History & evolution of IE; role of Industrial Engineer; Productivity concepts, Manufacturing and service sectors, Applications of IE.	5
II	Method Study: Process charts, flow diagrams, motion economy.	5

III	Work Measurement: Time study, PMTS, work sampling.	5
IV	Ergonomics & workplace design.	5
V	Facility Planning and Layout: Types, SLP.	5
VI	Replacement and Queuing Theory: Time value of money, depreciation, replacement, Queuing Theory-MM1.	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Assignments	Assignments on Modules 1, 2 and 3	10	10	Wk 4
	2	Assignments	Assignments on Modules 4, 5 and 6	15	10	Wk 11
MSE	3	Quiz	Based on Modules 1, 2 and 3	15	10	Wk 6
	4	Group Discussion	Based on Modules 1, 2 and 3	10	10	Wk 7
ESE	5	Applications of IE and presentations	Seminar on Modules 1, 2 and 3	15	10	Wk 14
	6	Open Book Exam	Modules 4, 5 and 6	35	10	Wk 16
			Total	100	60 hrs	

Text Books

1	Khanna O.P., “Industrial Engineering and Management”, Dhanpat Rai Publications (P) Ltd, New Delhi, 2021
2	Martand Telsang “Industrial Engineering and Production Management” S. Chand & Company Ltd., New Delhi, 2018
3	Introduction to Work Study, International Labor Organization, Fourth Revised Edition.

References

1	Bonnie Boardman, Introduction to Industrial Engineering, 2020. Available in OpenTextBook Library https://open.umn.edu/opentextbooks/textbooks/892
2	Gavrial Salvendy” Handbook of Industrial engineering” John Wiley and sons, New York, 2007.
3	M. I. Khan “Industrial Engineering” New age international(P) Ltd, New Delhi, 2009.

Useful Links

1	Principle of Industrial Engineering by Prof. D K Dwivedi, IIT Roorkee https://www.youtube.com/playlist?list=PLLy_2iUCG87D5n9zraFS2QYajk0OAOlVK
2	Industrial Engineering and Operations Research by Dr. Uday Shanker Dixit, IIT Guwahati https://youtube.com/playlist?list=PLwdnzlV3ogoX_AO-g9wEvUNu5cb_K- r45&si=ShNZawoX1-8AQPTh
3	https://www.iietindia.org.in/
4	https://iejournal.in/index.php

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7MD 264 Project Management for Infrastructure Development 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech.
Class, Semester	S. Y. B. Tech., Sem: IV
Course Code	7MD264
Course Name	Project Management for Infrastructure Development
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Provide students with a comprehensive understanding of project management principles, methodologies, and techniques
2. Deliver theoretical knowledge and practical insights into project planning, scheduling, cost management, quality control, and risk management in construction projects.
3. Equip students with the skills necessary to effectively plan, execute, and control construction projects, considering factors such as time, cost, quality, and stakeholder expectations.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Recall and comprehend the fundamental principles and concepts of construction project management.	Analyse	IV
CO2	Apply project management tools and techniques to plan, schedule, and control construction projects.	Apply	III
CO3	Critically evaluate and assess the performance of construction projects using project management metrics.	Evaluate	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1										2	3
CO2	1				2						2
CO3	2	1				3		2		2	

Module	Module Contents	Hours
I	**Introduction to Project Management** Overview of project management project: unique features, types, phases, and role in economic development Ethical conduct for civil engineers: importance, professional codes of ethics, and ethical decision-making, Project life cycle and stakeholders, Roles and responsibilities of a construction project manager, construction project management processes	4

II	**Project Planning and Scope Management** Importance of Construction Project Planning, Defining Project Objectives and Scope Work Breakdown Structure (WBS), Activity Sequencing and Dependency Relationships Estimating Activity Durations, Construction Project Scheduling Techniques-Introduction to project scheduling techniques Critical Path Method (CPM) and its applications in construction projects Developing project schedules using network diagrams Identifying critical activities and calculating float/slack Incorporating PERT analysis into project schedules	6
III	**Construction Materials Management and Cost Management:** Introduction to Materials Management, Material Procurement and Supplier Selection Inventory Management and Control Principles of inventory management in construction projects, Inventory control techniques (e.g., just-in-time, ABC analysis) Material handling and storage practices, Testing and inspection methods for construction materials, Quality assurance practices and standards, introduction to ERP systems and their role in materials management, Importance of cost codes for effective cost tracking and control, Time-Cost Trade-Off in Construction Projects, Principles and techniques of cost planning in construction projects, Value engineering and value analysis techniques	7
IV	**Project Monitoring and Control** Introduction to Project Monitoring and Control, Performance Measurement and Tracking, Earned Value Management (EVM), Management Information Systems (MIS) in Project Monitoring and Control, Communication and Reporting.	4
V	**Quality Management** Introduction to Quality Management, Quality Planning and Assurance, Introduction to Total Quality Management (TQM) principles and concepts, Application of TQM in construction projects, Quality improvement methodologies in TQM	5
VI	**Project Risk Management** Risk identification, assessment, and prioritization, Risk response planning and implementation, Risk monitoring and control. Contingency planning and mitigation strategies	4
		Total Hrs : 30

Text Books	
1	Kumar Neeraj Zha, "Construction Project Management", Pearson India Education, 1st edition,2011
2	Chitkara K K, "Construction Project Management: Planning, Scheduling and Controlling‖, Tata McGraw - Hill Education, 2nd edition, 2010
3	Seetharaman S., "Construction Project Management: Planning, Scheduling, and Control", Tata McGraw - Hill Education,1st edition, 2014

References	
1	Jha, Sinha, and Sinha "Construction Project Management: Theory and Practice'' Himalaya Publishing House, 2nd Edition 2019
2	P K Joy, Handbook of Construction Management, Macmillan India Limited,2nd edition (2000)
3	Barrie D.S. & Paulson B C, "Professional Construction Management", McGraw Hill

Useful Links	
1	https://nptel.ac.in/courses/110107430
2	https://nptel.ac.in/courses/110107081

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Group Discussion	A Group discussion will be held among students highlighting the importance of project management to national economic development	10	5	3
	2	Case Study Presentation	Students should visit and go through a construction project and present observed details.	10	10	5
MSE	3	Open Book Short Assignment	Students will go through an open book assignment on covered modules answering in details.	10	5	6
	4	Network Diagram & CPM Mini-task	Students are expected to be able to Draw a network diagram for a given set of activities and followed by Identifying the Critical Path, Calculation of float/ slack.	20	5	6
ESE	5	Blog Writing	Students are expected to write a technical blog highlighting importance of ERP In Materials and Quality Management	10	10	8
	6	Critical Problem Set Solving	Students are expected to solve a set of numerical problems including various parameters included in project like Earned Value Management (EVM)	10	5	10
	7	MIS Design Activity	Students are expected to Design a simple MIS report format for weekly project monitoring (progress charts, delays, issues).	10	5	11
	8	Risk Register Preparation	Students should attempt to Prepare a Risk Register for a typical construction project including: Risk description	10	5	12

			Probability/ impact rating, Mitigation strategies			
	9	Oral/Viva	Students will go through a Session covering questions across all units such as: Importance of ethics in construction TQM in project execution EVM indices interpretation Role of MIS, etc.	**10**	**10**	**13**
			Total	**100**	**60 hrs**	

7MD265 Data Interpretation and Analysis 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Systems Engineering
Class, Semester	SY BTech Sem - IV
Course Code	7MD265
Course Name	Data Interpretation and Analysis
Desired Requisites:	Basic knowledge of Statistics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

- To equip students with analytical tools to interpret quantitative data.
- To develop critical thinking and reasoning based on data.
- To enable students to visualize, summarize, and communicate data effectively.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Learn the basics of analytical tools to interpret quantitative data	Understand	II
CO2	Apply statistical principles to interpret the data	Apply	III
CO3	Analyse the data related to a given situation	Analyse	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		3		2	2						
CO2	1	2		2	1	1					
CO3		3		2							1

Module	Module Contents	Hours
I	Introduction to Data Analysis - Types of Data: Quantitative vs Qualitative - Levels of Measurement: Nominal, Ordinal, Interval, Ratio - Data Collection Methods - Introduction to Descriptive and Inferential Statistics	5
II	Data Visualization - Charts: Bar, Line, Pie, Histograms - Box Plots and Scatterplots - Multivariate Visualization - Dashboarding Tools (e.g., Tableau basics, Excel)	5
III	Descriptive Statistics - Measures of Central Tendency: Mean, Median, Mode - Measures of Dispersion: Range, Variance, Standard Deviation - Skewness and Kurtosis - Outlier Detection	5

IV	Data Interpretation Techniques - Tables and Graph-based Interpretation - Percentage Analysis and Ratios - Logical Reasoning from Data - Trend and Pattern Analysis	5
V	Correlation and Regression - Correlation Coefficient and its Interpretation - Simple Linear Regression - Multiple Regression Overview - Applications in Forecasting	5
VI	Applications and Case Studies - Case Study: Engineering or Business Data - Interpretation of Real-life Datasets (Industry/Survey Data) - Reporting and Storytelling with Data	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz	Quiz on Module I & II	10	8	4
	2	Quiz	Quiz on Module IV & V	10	8	10
MSE	**3**	Open Book + Critical Problem	Open Book Exam + Analytical Problems (Modules I–III)	30	14	8
ESE	**4**	Online Examination	Based on Entire Syllabus	25	10	12
	5	Seminar	Case Study Presentation	25	20	13 to 14
			Total	**100**	**60 hrs**	

Text Books

1	Sheldon M. Ross " Introduction to Probability and Statistics to Engineers and Scientists" 3rd edition (Indian)

References

1	R. Lyman Ott Michael Longnecker “An Introduction to Statistical Methods & Data Analysis “ CENGAGE Learning

Useful Links

1	https://onlinecourses.nptel.ac.in/noc26_cs07/preview
2	https://www.coursera.org/specializations/data-analysis?msockid=3c3c6e0333cf60ca3f01783832546189
3	

7MD266 Foundations of Quantum Computing 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM - Quantum Technology)
Class, Semester	SY B. Tech., Sem. IV
Course Code	7MD266
Course Name	Foundations of Quantum Computing
Desired Requisites:	Familiarity with Boolean Logic, Linear Algebra and Probability

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Introduce the mathematical foundations required for quantum technologies, including complex vector spaces, tensor products, and operator theory.
2. Develop an understanding of qubit systems, quantum states, Bloch sphere representation, and the distinction between pure and mixed states.
3. Provide practical skills in building and analyzing quantum circuits using modern quantum programming tools (e.g., Qiskit), including handling noise and basic communication protocols.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Apply mathematical concepts such as complex vectors, Dirac notation, tensor products, and operator properties to describe and analyze quantum states and transformations.	Understand	II
CO2	Represent and interpret single-qubit and multi-qubit states using statevectors, density matrices, and Bloch sphere geometrical interpretation.	Apply	III
CO3	Construct and simulate quantum circuits using fundamental and multi-qubit gates (X, Y, Z, H, RX, RY, RZ, CNOT) and demonstrate entanglement, interference, and basic quantum communication protocols.	Create	VI
CO4	Analyze outcomes of quantum measurements, evaluate circuit behavior under different measurement bases, and assess circuit performance under realistic noise models using Qiskit.	Evaluate	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	2	2	2						2
CO2	3	2	2	2	3						2
CO3	2	2	3	3	3			2	2	2	2
CO4	2	3	2	3	3			2	2	2	3

Module	**Module Contents**	**Hours**

I	**Mathematical Preliminaries:** Complex numbers, vectors, Dirac notation, Inner products, orthogonality, Tensor products: multi-dimensional states, Matrix representations of operators, Unitary and Hermitian operators.	3
II	**Qubits & State Representation:** Classical bit vs qubit, Single-qubit states $\|0\rangle$, $\|1\rangle$, superposition, Bloch sphere representation, Global vs relative phase, Density matrices (intro), Mixed states vs pure states	3
III	**Quantum Gates:** Unitary transformations and quantum gates, Pauli gates (X, Y, Z), Hadamard and phase gates (H, S, T), Rotation gates: RX, RY, RZ, Multi-qubit gates: CNOT, Controlled gates: CZ, CCNOT (Toffoli), Universal gate sets, Circuit diagrams and decomposition basics	4
IV	**Multi-Qubit Systems & Entanglement:** Tensor product for 2-qubit systems, Bell states, Entanglement measures (qualitative), Quantum interference, Superdense coding, Quantum teleportation, No-cloning theorem	3
V	**Quantum Measurement Theory:** Measurement postulates,Observable operators, Born rule and probabilities, Measurement in different bases, Collapse of wavefunction and implications.	3
VI	**Quantum Circuits & Computation Model:** Quantum circuit model, Gate-level circuit construction, Time evolution and unitaries, Circuit depth and size, Reversible computing foundations, Introduction to noise & real hardware limitations.	4
		Total Hrs : 20+10=30

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz + Coding/Simulation Task	Short quiz on quantum preliminaries + simple Qiskit coding (state preparation, single-qubit gates)	10	7 hrs	3
	2	Case Study / Presentation	Group presentation on quantum applications (ex: quantum cryptography, quantum sensing, QML) with justification of quantum advantage	10	7 hrs	5
MSE	3	Mid-Semester Examination	Written test covering Modules I–III (theory + short numericals)	30	12 hrs	7
ESE	4	Practical Evaluation	Hands-on Qiskit implementation of quantum gates	15	9 hrs	10
	5	Quantum Mini-Project	Small project implementing protocols like coding / demonstration → result interpretation	15	9 hrs	11
	6	Viva-Voce / Oral Examination	Oral exam covering circuits, interference, measurement, hardware	10	6 hrs	12
	7	Portfolio / Reflection Activity	Submission of Qiskit portfolio (circuit diagrams, output screenshots, observations, reflections)	10	10 hrs	14
			Total	100	60 hrs	

Text Books

1	Nielsen, M. A., & Chuang, I. L. (2010). Quantum computation and quantum information (10th anniversary ed.). Cambridge University Press.
2	Das, A. (2021). Foundations of quantum computing. Universities Press.
3	Benenti, G., Casati, G., & Strini, G. (2007). Principles of quantum computation and information: Volume I—Basic concepts. World Scientific Publishing.
4	Yanofsky, N. S., & Mannucci, M. A. (2013). Quantum computing for computer scientists. Cambridge University Press.

References

1	Sutor, R. S. (2019). Programming quantum computers: Essential algorithms and code samples for quantum computing. O'Reilly Media.
2	Kaye, P., Laflamme, R., & Mosca, M. (2007). An introduction to quantum computing. Oxford University Press.
3	Sengupta, A., & Chattopadhyay, A. (2020). Quantum computing and quantum communication. Springer.
Useful Links	
1	Introduction to Quantum Computing (Dr. Vinay Hegde, IIT Bombay: NPTEL) https://nptel.ac.in/courses/106106222
2	Quantum Computing (Dr. Shalabh Bhatnagar, IISc Bangalore: NPTEL) https://nptel.ac.in/courses/108108172
3	Quantum Information and Computation (Prof. Prasanta Panigrahi, IISER Kolkata: NPTEL) https://nptel.ac.in/courses/115105129

7MD 267 Fundamentals of Innovation and Entrepreneurship 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Innovation and Entrepreneurship development
Class, Semester	SY IV
Course Code	7MD267
Course Name	Fundamentals of Innovation and Entrepreneurship
Desired Requisites:	Understanding Incubation and Entrepreneurship - Course

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

After completing this course, students will be able to:

- **Understand** fundamental management principles and their role in fostering innovation and entrepreneurial initiatives within organizations.
- **Develop** an entrepreneurial mindset grounded in values, motivation, creativity, and ethical decision-making.
- **Apply** structured creativity, critical thinking, and problem-solving tools to identify innovation opportunities and generate viable solutions.
- **Analyse and manage** opportunities and risks to create sustainable value through systematic innovation processes.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**Explain** classical and contemporary management concepts and their relevance in supporting innovation and entrepreneurial culture.	Understand	I
CO2	**Apply** creativity, critical thinking, and structured problem-solving techniques to generate and refine innovative ideas.	Apply	III
CO3	**Analyse** opportunities and risks using market insights, user needs, and feasibility tools to evaluate innovation potential.	Analyse	IV
CO4	**Design and justify** value-creating solutions using design thinking, prototyping, and evidence-based experimentation.	Create	V

CO – PO mapping

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

Module	Module Contents	Hours
I	**Foundations of Management and Innovation** Covers classical and modern management theories, emphasizing planning, organizing, leading and controlling within innovative environments. Explains how management principles support creativity, experimentation and structured innovation. Introduces organizational culture that encourages idea generation and continuous improvement. Highlights the importance of management systems in nurturing entrepreneurial initiatives.	5
II	**Entrepreneurial Mindset, Values and Motivation** Explores key entrepreneurial values such as resilience, integrity, ownership and learning orientation. Emphasizes the mindset needed to innovate, challenge assumptions and navigate uncertainty. Helps students recognise their own strengths and motivations as emerging innovators. Connects entrepreneurial behaviour with long-term value creation.	5
III	**Creativity, Critical Thinking and Problem-Solving for Innovation** Focuses on how to think creatively using structured tools like brainstorming, SCAMPER and mind-mapping to generate novel solutions. Introduces critical thinking approaches for analysing problems, identifying root causes and evaluating ideas objectively. Demonstrates importance of first-principles thinking in innovative product development. Shows how creativity becomes a systematic process rather than accidental inspiration.	5
IV	**Opportunity Identification and Innovation Relevance** Explains how innovators discover unmet needs through observation, user empathy and market analysis. Demonstrates the link between creativity and opportunity recognition by converting problems into viable ideas. Highlights the importance of innovation in driving competitive advantage and societal impact. Introduces tools for assessing opportunity size, relevance and feasibility.	5
V	**Value Creation and Innovation Design** Shows how innovators convert ideas into meaningful value through design thinking and customer-centric development. Emphasizes understanding user pains, gains and jobs-to-be-done to craft strong value propositions. Explores the importance of rapid prototyping, MVPs and feedback loops in refining solutions. Demonstrates how innovation contributes to long-term value for users, markets and communities.	5
VI	**Risk, Uncertainty and Strategic Opportunity Management** Covers types of entrepreneurial risks—market, financial, technical and operational—and methods to analyse them. Explains how innovators manage uncertainty through experimentation, validation and early testing. Shows how opportunity and risk coexist, requiring evidence-based decision making. Reinforces that successful innovation arises from calculated risk-taking aligned with strategic vision.	5
		Total Hrs : 30
Course Assessment Plan (*for total 60 learning hours)*		

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz / Online Tools (4)	Online quiz/crossword on management and innovation basics	5	2	Week 2
	2	Group Discussion (1)	Discussion on role of management in innovation and entrepreneurship	5	2	Week 3
	3	Concept Mapping (19)	Mapping links between creativity, opportunity, value and risk	10	2	Week 4
MSE	4	Case Study Presentation (5)	Startup/innovation case analysis with focus on opportunity and value	10	4	Week 5
	5	Digital Poster Making (6)	Visual presentation of innovative idea/solution	5	3	Week 6
	6	Debate (2)	Debate on innovation, risk and uncertainty	5	2	Week 7
	7	Business Model Canvas (20)	Development of BMC for proposed innovation	10	4	Week 8
ESE	8	Idea Contest	Idea pitching and peer evaluation	10	4	Week 9
	9	Prototype Making / Design Challenge	Low-fidelity prototype or design challenge	10	5	Week 10
	10	Presentation	Integrated innovation mini-project (problem → solution → value)	20	8	Week 11–12
	11	Seminar	Seminar on innovation trends / startup ecosystem	10	2	Week 13

Text Books

1	*Innovation and Entrepreneurship: Practice and Principles*, Peter F. Drucker, Harper Business, 2006 Edition.
2	*Management*, Stephen P. Robbins and Mary Coulter, Pearson Education, 14th Edition.
3	*Entrepreneurship Development*, R. Srinivasan, Tata McGraw-Hill Education, 2nd Edition.

References

1	*Business Model Generation*, Alexander Osterwalder and Yves Pigneur, Wiley, 1st Edition.
2	*The Lean Startup*, Eric Ries, Crown Business, 1st Edition.
3	*The Innovator's Dilemma*, Clayton M. Christensen, Harvard Business Review Press, 1st Edition.

Useful Links

1	**IDEO U – Design Thinking Resources** https://www.ideou.com *(Practical learning on creativity, problem solving, design thinking, and value creativity)*
2	**Harvard Business Review – Innovation & Strategy Articles** https://hbr.org *(Short, readable articles on innovation, leadership, risk, strategy, and entrepreneurship)*

7MD268 Introduction to Urban Planning 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Smart Cities
Class, Semester	S Y B.Tech Semester IV
Course Code	7MD268
Course Name	Introduction to Urban Planning
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

To understand the evolution and Foundations of Urban Planning, analyse urbanization Patterns and Growth Dynamics and assess urban Planning Principles to Address Contemporary Challenges.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Understand town planning concepts and theories.	Understanding	II
CO2	Recognize the concepts for different area planning.	Analyzing	IV
CO3	Implement different guidelines, norms, land use planning policies, and survey techniques.	Applying	III
CO4	Assess the challenges involved in the urban planning.	Analyzing	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**
CO 1	1					1					1
CO 2	1										1
CO 3	2										1
CO 4	1	1				1					2

Module	**Module Contents**	**Hours**

I	**Evolution of Town Planning** Evolution in planning and physical form, Concept of urban human settlement, Differentiation between rural and urban settlement, concept of town, Evolved and Created Town Characteristics, Features of urban planning process, Role of urban planner, Genesis of urban form; Social, Geographical and Cultural impacts, Contemporary developments in planning, Impacts of Industrial revolution on town and regional planning, Characteristics of settlements.	5
II	**Urbanization** Salient features of Indian Urbanisation with specific reference to Maharashtra, Challenges of Urbanisation, Planning system framework, Levels of planning in India.	5
III	**Urban Growth** Elements of town structure, Town classification: Functional and geographical; City Centre, walled city and Urban Fringe areas; classification based on socio-cultural characteristics, changes with time and growth, growth theories, Characteristics of the urban environment and its components, Modern urban forms, peri- Urban Areas- Urban Fringe- Issues	5
IV	**Development Plan** Difference between Structure Plan and Development Plan, Classification of Towns, Surveys, Analysis and Projections, Demographic projections, Goals and Objectives, Public participation, Implementation and financial aspects, Relation with Regional Plan, Contents of D.P., Planning norms, Modifications to sanctioned DP, Modifications of substantial nature, Notices under section 49 and 127, Process of DP preparation, publication, submission and approval as per provisions of MR and TP Act, 1966.	5
V	**Current events and Technology** Current events of national and international importance –Industrial, Economic, Spatial Planning , Urban Development, Technology - Applications of Total station, Drone, Remote sensing , GIS, GPS, Computer-Aided Design in Urban Planning.	5
VI	**Town Planning Scheme** Concept, Preparation of TP Scheme as per provisions of MR and TP Act, 1966, Relation with DP, Original Plot, Final Plot, Semi-final plot , Incremental contribution and rationale for charging it, Contents of TPS, Cost of TPS, Advance possession, Amenities partially beneficial, Functions of Arbitrator, Functions of Tribunal of Appeal.	5
		Total Hrs: 30

Course Assessment Plan (*for total 60 learning hours*)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz using Online Tools	Quick assessment of conceptual understanding of Evaluation of town planning.	10	2	
	2	Quiz using Online Tools	Technical quiz on Development Plan.	10	3	
MSE	**3**	Technical Presentation	Presentation on Salient features of Indian Urbanisation with specific reference to Maharashtra, Characteristics of the urban environment and its components.	30	20	

ESE	**4**	Seminar/Case Study	Case study of development plan of different states (group activity).	25	25	
	6	Seminar/Case Study	Case study of Sangli city - Challenges of Urbanisation.	25	10	
			Total	**100**	**60 hrs**	

Text Books	
1	K. C. Shivrama Krishnan, “Revisioning Indian Cities”, Sage Publications.
2	R. Ramachandran, “Urbanisation and Urban Systems in India”, Oxford Publications.
3	Urban and Regional Development Plan Formulations and implementation (URDPFI) guidelines, 2015.
References	
1	A.B. Gillion and Simon Eisner, “The Urban Pattern”, CBS Publishers and Distributors, Delhi.
2	Rishma A., “Town Planning in Hot Cities”, Mir Publishers, Moscow..
3	Ward S (2002), “Planning the 20th Century City” John Wiler & Sons.
4	Rangwala S.C “Town Planning”
Useful Links	
1	https://youtu.be/q_XmlG3CwNk?si=VP4rKCERXLKlgspV
2	https://youtu.be/RqdaT3LLctU?si=uSUnIy4fX8IX8K2K
3	https://onlinecourses.nptel.ac.in/noc22_ar18/preview

7MD269 Introduction to Electric Vehicles 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in EV
Class, Semester	SY BTech Sem - IV
Course Code	7MD269
Course Name	Introduction to Electric Vehicle
Desired Requisites:	Basic knowledge of electrical engineering, electronics, vehicle fundamentals, and physics–mathematics required for understanding EV systems.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

- Study the key components of EVs, such as batteries, electric motors, inverters, charging systems, and energy management systems.
- Gain knowledge of the electric powertrain, including electric motors, controllers, and battery management systems.
- Investigate the global market trends for EV adoption, including government incentives, market barriers, and consumer behaviour

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Learn the basics of EVs, including their components, how they differ from internal combustion engine (ICE) vehicles, and their importance	Understand	II
CO2	Design and analyse the electric powertrain system of an EV, including electric motor selection, inverter design, and drivetrain integration.	Analyse	III
CO3	Evaluate the performance characteristics of electric vehicles, including acceleration, braking, and overall efficiency, and relate these to vehicle design parameters.	Evaluate	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3									1	
CO2		3	3	1					3		
CO3	2	2		3			2				

Module	**Module Contents**	**Hours**
I	**Background Details to Electric Vehicle (EV)** EV Historical Background, EV Benefits of Using EVs, EV Overview of types of EVs and its Challenges, EV Motor Drive Technologies, EV Energy Source Technologies	4

II	**Electric Vehicle Dynamics (Subsystems and Configuration)** EV Subsystems and Modes of Operation, Vehicle Dynamics intro and tractive effort Configuration locomotive drives- series parallel switching- load tracking architecture. Mild hybrid- power assist- dual mode- power split- power split with shift, Continuously Variable transmission (CVT)- wheel motors.	6
III	**Electrical & Electronic Components** Purpose and operation of electrical components like switches, relays, solenoids etc. Purpose of circuit protection devices like fuses, circuit breakers and fusible links. Working of Electromagnetic gauges like temp Gauges, fuel gauge, engine oil pressure gauge, Speedo-meter gauge. Working of electrical accessories like windshield wiper, washer pumps, electrochromic mirror, power window, power seat, power door lock.	5
IV	**Clutches, Gear Box and Final Drive** Principle, functions, general requirements, types of clutches Necessity of gear box, Requirements of gear box, Functions of gear box, Types of gears used in transmission, Gear shifting mechanism. Propeller shaft, universal joints, hooks and constant velocity joints, Drive line arrangements –Different types of final drives, need of differential.	4
V	**Battery (Fuel Cells)** Lead acid battery–components & operation. Maintenance free battery–construction. Concept of Low maintenance battery. Battery maintenance and safety precautions. Battery testing–Battery terminal test, Leakage test, Open circuit test, Capacity test. Battery charging–Initial charging procedure, dry charged battery precautions. Jump Starting-Procedure and precautions. Factors affecting battery life. Battery failures–cycle failure, internal short circuit, over charging.	6
VI	**Brake, Steering and Suspension System** Concept, function, working principle and necessity of brakes. Classification of brakes and braking systems. Electrical braking systems. Concept, function, working principle of Steering system. Electric power steering system (EPS) and its components. Concept, function, working principle and necessity of suspension system (ESS), electronic suspension system (ESS)	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours*)

		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz + Case Study	Quiz + Case-based Assignment (Module I & II)	10	6	3
	2	Design Challenge + Concept Map	Design Challenge + Concept Map (Module III)	10	6	6
MSE	**3**	Open Book + Critical Problem	Open Book Exam + Analytical Problems (Modules I–III)	30	12	8
	4	Mini Project / Prototype	Mini Project / Prototype (Modules IV & V)	15	10	11
ESE	**5**	Viva + Seminar	Viva/Oral + Seminar (Modules I–VI)	10	6	12
	6	Open Book Theory Exam	Final Theory Examination (Modules I–VI)	25	20	14
			Total	**100**	**60 hrs**	

Text Books

1	Sandeep Dhameja "Electric Vehicle Technology" Macmillan India 2009
2	G. S. S. Raju & K. R. Padiyar "Electric Vehicles: The Way Forward" Wiley India 2017
3	D. K. Kothari & I. J. Nagrath "Electric Vehicle Engineering"McGraw-Hill Education 2019

References

1	John M. Miller "Electric Vehicle Engineering" CRC Press 2010

2	James L. W. Meintjes "Electric and Hybrid Vehicles: Design Fundamentals" CRC Press 2012
3	Ali Emadi "Advanced Electric Drive Vehicles" CRC Press 2014
4	S. K. Gupta "Hybrid Electric Vehicles: Principles, Design, and Applications" PHI Learning Private Limited 2012
Useful Links	
1	https://archive.nptel.ac.in/courses/108/106/108106170/
2	https://nptel.ac.in/courses/108102121
3	https://www.shiksha.com/online-courses/fundamentals-of-electric-vehicles-technology-economics-course-nptel818

7MD270 Introduction to Financial Markets 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in FinTech
Class, Semester	S Y B. Tech. SEM-IV
Course Code	7MD270
Course Name	Introduction to Financial Markets
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To develop a strong foundation in basic accounting principles, concepts, and financial reporting.
2. To provide a comprehensive understanding of financial statements, financial ratios, and their interpretation for decision-making.
3. To introduce students to the structure, functions, and regulatory framework of financial markets in India.
4. To equip learners with knowledge of key capital market instruments — equity, debt, mutual funds, and alternative investments — along with their valuation and risk-return characteristics.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Apply fundamental accounting principles to record transactions, prepare ledgers, and generate basic financial statements.	Apply	3
CO2	Analyse and interpret balance sheets, profit & loss accounts, cash flow statements, and financial ratios for evaluating financial performance.	Analyse	4
CO3	Explain the functioning of financial markets and the role of key regulators such as SEBI and RBI in maintaining market stability.	Understand	2
CO4	Differentiate between equity, debt, mutual funds, and alternative investment products and evaluate investment options based on risk, return, and market conditions.	Evaluate	5

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2				2	2				
CO2	3	2	2			2	2				
CO3	3	3	2								
CO4	2	3	2			2	2				

Module	Module Contents	Hours
I	Basics of Accounting — Principles and Concepts Financial Accounting: Key accounting principles and concepts, significance of accounting. Accrual vs. cash accounting, double-entry bookkeeping. Overview of the accounting cycle: Journal, ledger, trial balance.	4

II	Financial Statements and Ratios, Understanding financial statements: Balance Sheet, Profit & Loss Account, and Cash Flow Statement. Financial ratios and their implications: Liquidity, profitability, and leverage ratios. Practical exercises: Preparing basic financial statements	6
III	Overview of financial systems: Intermediaries, regulators, and participants. Functions of financial markets: Allocation of resources, risk management, and price discovery. Types of financial markets: Money Market vs. Capital Market; Primary vs. Secondary Market. Regulatory Framework in India: Role of SEBI and RBI.	5
IV	Capital Market Instruments — Equity, Equity instruments: Share and Stock Market operations - IPOs, FPOs, stock exchanges, indices, and trading mechanisms, Key factors influencing equity prices, Risk-return trade-off in equity investments.	5
V	Capital Market Instruments — Debt, Debt instruments: Bonds, debentures, and fixed-income securities. Bond valuation, yield, maturity, and duration.	5
VI	Mutual Funds and Alternative Investments, Overview of mutual funds: Structure, types, and advantages. Net Asset Value (NAV) and fund performance metrics. Introduction to alternative investments: Real estate, commodities, private equity and hedge funds. Fund Types: Active vs. Passive, ETFs, Index Funds	5
	Total Hrs : 30	

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment + Practice Problems	Assignment on **Module 1 & Module 2**: journal entries, ledger posting, trial balance, preparation of simple financial statements, and basic ratio calculations.	**10**	**6 hours**	Week 3
	2	Mini-Task	Short case on **Module 3**: identifying financial market components, regulators (SEBI/RBI), primary vs secondary market, and money vs capital market.	**10**	**6 hours**	Week 6
MSE	**3**	Examination(MCQ or descriptive)	Written exam covering **Module 1, 2, and 3** with problem-solving (ratios, statements) and short conceptual questions.	**30**	**12 hours**	Week 8
	4	**Case-Based Examination (Application Focused)**	Exam on **Modules 4–6** using scenarios for equity, debt, mutual funds, and price movement concepts.	20	10	12
ESE	**5**	Exam (MCQ or descriptive)	**Optional component inside**, includes scenario-based questions on **Modules 4, 5 & 6** (equity, debt, mutual funds).	30	**10 hours**	Week 16
			Total	**100**	**60 hrs**	

Text Books

1	Bharati V. Pathak, **"Indian Financial System"**, Pearson Education, 6th Edition, 2023
2	H. R. Machiraju, **"Indian Financial System"**, Vikas Publishing House, LPSPE Edition, 2023
3	L. M. Bhole & Jitendra Mahakud, **"Financial Institutions and Markets"**, McGraw Hill Education, 6th Edition, 2017
4	Dr. Vinod Kumar & Manmeet Kaur, "Financial Markets & Institutions", Taxmann, 4th Edition, 2025

References

1	Vasant Desai, "The Indian Financial System", Himalaya Publishing House, 12th Edition, 2023
2	V. A. Avadhani, "Investment Management", Himalaya Publishing House, 8th Edition, 2025
3	V. A. Avadhani, "Financial Services in India", Himalaya Publishing House, 3rd Edition, 2024

Useful Links	
1	**NISM – National Institute of Securities Markets (Study Material & Certifications)** https://nism.ac.in/online-examinations/nflq/
2	**RBI – Reserve Bank of India (Financial System & Regulations)** https://www.rbi.org.in
3	**Oliveboard – Financial Markets & Instruments (Articles & Guides)** https://www.oliveboard.in/blog/financial-markets/

7MD271 Fundamentals of Robotics and Automation 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Robotics and Automation
Class, Semester	SY B. Tech., Sem IV
Course Code	7MD271
Course Name	Fundamentals of Robotics and Automation
Desired Requisites:	working knowledge of core scientific principles, specifically in Physics and Mathematics, The ability to observe, interpret, and critically understand complex systems and information.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr/ Week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To understand the fundamentals of Robotics.
2. To learn the working of- Sensors, End Effectors, Drives.
3. To learn the basics of Drives and Power Transmission Systems in Robotics.
4. To learn basics of Automation and Material Handling Systems.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Recall fundamentals of Robot Anatomy, Sensors, End Effectors, Drives and Power Transmission.	I	Remembering
CO2	Explain the Components, working of Robot Components, Sensors, End Effectors, Power Transmission and Drives.	II	Understanding
CO3	Select appropriate Sensors, End Effectors, Drives and Transmission Elements.	III	Applying
CO4	Select appropriate components of robotics and automation, automated material handling systems.	III	Applying

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**
CO 1	3					1					
CO 2	3	1				1					
CO 3	3	2	2			1					
CO 4	3	2	2			1	1				1

Module	**Module Contents**	**Hours**

I	**Fundamentals of Robotics** Historical development of Robotics, Definitions of Industrial Robot, Types and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Resolution, accuracy and precision of robot.	**5**
II	**Sensors in Robotics** Sensor characteristics, Position sensors, Encoders, Velocity sensors, Proximity sensors, Limit switches, Tactile sensors, Force and torque sensors, Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches, Introduction to machine vision.	**5**
III	**End Effectors** Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations.	**5**
IV	**Robot Drives and Power Transmission** Robot drive systems, Types - Pneumatic, Hydraulic, Mechanical, Electrical Drives, Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Power Transmission used in Robotics.	**5**
V	**Automation** Definition, reasons for automating. Types of production and types of automation, levels of automation, Basic elements of automated systems-power, program and control.	**5**
VI	**Material Handling Systems** Material handling introduction, Unit Load, Palletizing, Material Transport Equipment automated guided vehicles (AGV), Rail-Guided Vehicles(RGV), Conveyors- Types of Conveyors, Pick and Place Robots.	**5**
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Case Study Presentation	Industry-oriented problem statements	**10**	**10**	**3**
	2	Industry Visit	Exposure to Industry	**10**	**10**	**11**
MSE	**3**	Short Quizzes / Unit Tests	Concept-based MCQs	**30**	**10**	**9**
ESE	**4**	Mini-Project	Small application-oriented projects which includes design and report preparation	**30**	**20**	**13**
	5	Oral/Viva Exam	Concept understanding	**20**	**10**	**13**
			Total	**100**	**60 hrs**	

Text Books

1	Groover, Mikell P. Industrial Robotics : Technology, Programming, and Applications. 2nd ed., Special Indian ed, McGraw-Hills1986. ISBN: 9781259006210

2	Saha, Subir Kumar. Introduction to Robotics. Second edition, McGraw Hill Education (India) Private Limited, 2014. ISBN: 9785332902800
3	Craig, John J, "Introduction to Robotics : Mechanics and Control", Fourth edition, Pearson, 2018., ISBN: 9780133489798
4	Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall, 1989. ISBN: 9780133361650
5	Poole, Harry H., "Fundamentals of Robotics Engineering", Springer Netherlands, 2012, ISBN: 9789401170505
References	
1	Niku, Saeed B. Introduction to Robotics : Analysis, Control, Applications. 2nd ed, Wiley, 2011. ISBN-13 : 978-9332902800
2	Khatib, Oussama, and Bruno Siciliano, "Springer I4andbook of Robotics", 2nd edition, Springer International Publishing: Imprint : Springer, 2016, ISBN: 9783319325521
3	P.I. Corke, "Robotics, Vision & Control" Second edition, Springer, 2017, ISBN 978-3- 319-54413-7
4	Ghosal, Ashitava. Robotics : Fundamental Concepts and Analysis. Oxford University Press, 2006. ISBN: 9780195673913
5	Mittal, R. K., and I. J. Nagrath. Robotics and Control. Tata McGraw-Hill, 2003. ISBN-13 : 978-9332902800
Useful Links	
1	https://www.automate.org/conpanies/robotic-industies-association
2	https://www.ieee-ras.org/
3	https://www.roboticstomorrow.com/
4	https://www.designworldonline.com/
5	https://www.therobotreport.com/
6	https://robohub.org/
7	https://www.sciencedaily.com/news/computers_math/robotics/
8	https://techXplore.com/robotics-news/
9	https://nptel.ac.in/courses/107106090
10	https://n ptel.ac.in/courses/112105249
11	https://onlinecourses.nptel.ac.in/noc2l_me32/preview
12	https://archive.nptel.ac.in/courses/112/101/11210 1099/
13	https://archive.nptel.ac. in/courses/112/107/112107289/

7MD272 Electronic Devices and Circuits 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Electronics Engineering
Class, Semester	Second Year B. Tech., Sem.-IV
Course Code	7MD272
Course Name	Electronic Devices and Circuits
Desired Requisites:	Basic Electrical and Electronics Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To explain the working of diode circuits and electronic circuits like small signal amplifiers, power amplifiers using BJT and MOSFETs.
2. To illustrate the methods used for AC/DC analysis of transistorized and op-amp based circuits.
3. To Explain the working of power semiconductor devices and electrical power converter circuits.
4. To explain the working of oscillators, multivibrators, timing circuits and voltage regulators.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**Explain** the working of diode circuits, transistorized and op-amp based circuits.	Understand	II
CO2	**Explain** the working of power semiconductor devices such as SCR, GTO, Power MOSFET and IGBT and power electronics circuits.	Understand	II
CO3	**Explain** the working of oscillators, multivibrators and applications of operational amplifier in analog computations.	Understand	II
CO4	**Solve** the examples on diode circuits, amplifiers, voltage regulators and op-amp based circuits considering ideal op-amp.	Applying	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3									
CO2	2	3									
CO3		3	3								
CO4			3								

Module	Module Contents	Hours
I	**Diode Circuits:** Rectifier circuits, RC filter circuit, Zener diode voltage regulator, voltage multiplier circuits, diode logic circuits, photodiode and LED circuits.	**4**
II	**Transistorized Amplifiers:** Amplifier fundamentals, small signal amplifiers: common emitter amplifier, common collector amplifier; JFET/MOSFET common source/ common drain amplifier, frequency response of amplifiers.	**7**

III	**Power Amplifiers** Classification of power amplifiers: class-A, class-B, class-AB, class-C power amplifiers; transformer-coupled amplifiers, heat sink and its operation	**5**
IV	**Op-Amp Applications**: Differential amplifier, unity gain buffer (voltage follower), voltage comparator, zero crossing detector, effect of positive feedback, Schmitt trigger circuit, multivibrators, types of oscillators, RC oscillators, monolithic timers (IC555).	**6**
V	**Power Semiconductor Devices and Circuits:** SCR, TRIAC, DIAC, GTO, Power MOSFET and IGBT; controlled rectifiers, ac voltage controllers, inverter, chopper, UPS,	**4**
VI	**Regulated DC Power Supply:** Block diagram of regulated dc power supply, Zener diode voltage regulator, op-amp based voltage regulator, three terminal IC voltage regulator, switching regulators.	**4**
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Assignments**	Based on Diode Circuits and Amplifiers	**15**	**8**	**3**
	2	**Article Discussion**	Applications of semiconductor diode and small signal amplifiers	**5**	**2**	**4**
MSE	**3**	**Short Quiz/ MCQ Test**	Diode Circuits and Small Signal and Large Signal Amplifiers	**20**	**10**	**6**
	4	**Seminar**	Applications of Amplifier Circuits	**10**	**5**	**8**
ESE	**5**	**Quiz/ MCQ Test**	Ideal Op-Amp Circuit Analysis and Applications of op-amp	**30**	**20**	**12**
	6	**Mini Project**	Simulation of Electronic Circuits using simulation software	**10**	**10**	**13**
	7	**Oral/ Viva Exam**	All modules and to evaluate the understanding of electronic devices and circuits	**10**	**5**	**14**
	8……..					
			Total	**100**	**60 hrs**	

Text Books

1	R. Boylestad and L. Nashelsky, "*Electronic Devices and Circuit Theory*", 9th Edition, PHI, 2009.
2	D. A. Neamen, "*Microelectronics: Circuit Analysis and Design*", 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2021.
3	Ramakant Gaikwad, "Op-amp and Linear Integrated Circuits", 4th Edition, Pearson, 2015.
4	M.H. Rashid, "*Power Electronics: Circuits, Devices & Applications*", 3rd Edition, PHI, New Delhi, 2008.

References	
1	Albert Malvino, David J. Bates, “Electronic Principles”, 7th Edition, McGraw Hill Education, 2017.
2	Robert F. Coughlin and Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits," Pearson Education, 2009.
3	M. D. Singh & K. B. Khanchandani, “*Power Electronics*”, Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
Useful Links	
1	https://nptel.ac.in/courses/108101091
2	https://nptel.ac.in/courses/108105158
3	https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_operational_amplifiers.htm
4	https://nptel.ac.in/courses/108/105/108105066/#

7MD273 Data Structure and Algorithm 2 0 0 2 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Information Technology
Class, Semester	SY B.Tech , Semester IV
Course Code	7MD273
Course Name	Data Structure and Algorithm
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction					
Tutorial	-	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. Exploring basics of data structures and algorithms.
2. Introduces a linear and non linear data structures
3. Familiarize sorting and pattern matching algorithms

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Apply various data structures for problem solving	III	Applying
CO2	Apply important algorithmic design paradigms and methods of analysis	III	Applying
CO3	Compare various Searching and sorting techniques	IV	Analyzing
CO4	Evaluate efficiency of the programs based on performance of the algorithm	V	Evaluating

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	2								
CO2	2	2									
CO3	2	3	2		3			2			1
CO4	3	2		2	2			1	2		

Module	Module Contents	Hours
I	**Introduction** Basic Concepts: Algorithm, Pseudo-code, ADT, Data Structure, Algorithmic Efficiency, And Recursion, Dynamic Memory allocation, Introduction of Pointers to Arrays ,functions and Structures	4
II	**Linear Lists, Stacks and Queues** Sequential and linked implementations, equivalence problem, linked lists, doubly linked lists, circular lists	5
III	**Non-Linear Structures** Basic terminology, binary trees and its representation, binary tree traversals , operations	5
IV	**Searching and Sorting Techniques:** Importance of searching, Sequential, Binary, Insertion Sort, Bubble Sort, Quick sort and Merge sort	6

V	**Introduction to Computer Algorithm** Design and Analysis of Algorithm Greedy Algorithms: Knapsack problem, Huffman codes, Dynamic Programming	5
VI	**Backtracking Programming** Concept, Advantages & Disadvantages, Applications, Implementation using problems like N-Queen Problem	5
		Total Hrs : 30

List of Laboratory Experiments/ Practicals (if applicable)

1. Program based on structures and pointers in C
2. Program based on arrays and pointers in C
3. File handling and command line arguments
4. Implementation of recursive and non-recursive tree traversals
5. Implementation of searching : linear search, binary search, Fibonacci search
6. Sorting Methods: Insertion sort, shell sort, heap sort, quick sort, merge sort, radix sort etc.
7. write a program using Greedy algorithm to compute maximum profit in fractional knapsack.
8. Write a program using Greedy algorithm to compute maximum profit in fractional knapsack.

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Design of Experiment	Design & implement structures and pointers program in C	10	6 hrs	Week 2
	2	Quiz / Crossword using Online Tools	Quiz on Linear Lists, Stacks, Queues & linked implementations	10	6 hrs	Week 4
MSE	3	Case Study Presentation	Case study on Binary Tree representation & operations	15	8 hrs	Week 6
	4	App / Website Making	Mini Web/App demonstrating Searching & Sorting visualizer	15	8 hrs	Week 8
ESE	5	Online Coding Challenge	Participation on HackerRank / LeetCode solving problems on Greedy Algorithms (Knapsack, Huffman) & Dynamic Programming	20	10 hrs	Week 10

	6	Internal Coding Competition	Internal coding competition in group of 3 for dynamic programming	10	5 hrs	Week 11
	7	Assignments	Assignment on Backtracking applications	10	6 hrs	Week 12
	8	Final Assignment + Viva / Demonstration	End-semester project-based practical including complete syllabus	10	5 hrs	Week 13
			Total	**100**	**60 hrs**	

Text Books	
1	Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures, A Pseudocode Approach With C”, Cengage Learning, 2nd Edition, 2005
2	S. Lipschutz, “Data Structures with C”, Schaum's Outlines Series, Tata McGraw-Hill, 1st edition, 2010
References	
1	Yashavant Kanetkar, “Understanding pointers in C”, 3rdedition, BPB Publication
2	Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, 2ndEdition, Prentice Hall of India
Useful Links	
1	https://nptel.ac.in/courses/106/102/106102064/
2	https://nptel.ac.in/courses/106/106/106106127/

7MD274 Data Structure and Algorithm 2 0 0 2 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Computer Science Engineering
Class, Semester	SY B. Tech., Sem IV
Course Code	7MD274
Course Name	Data Structures and Algorithms
Desired Requisites:	Programming basics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	20	50	100
Practical	2 Hrs /week	**Credits: 3**			

Course Objectives

1. To develop and improve logical thinking and to make the students capable of applying appropriate data structure for solving a given problem.
2. To explain and demonstrate different algorithm techniques for solving real world problem.
3. To provide a foundation to analyse and compare various searching and sorting techniques and to select optimal techniques to solve the problem.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	To describe the fundamental concepts of linear data structures and algorithm design, analysis techniques.	II	Understanding
CO2	To apply knowledge of computing and mathematics, data structures to solve the problems.	III	Applying
CO3	To analyze the various algorithm design techniques for a given problem.	IV	Analyzing
CO4	To assess various data structures and algorithms.	V	Evaluating

CO – PO mapping

	Programme Outcomes (PO)										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2										
CO2	2	3	2								
CO3	2	3	2								
CO4	2	2	2	2							

Module	Module Contents	Hours
I	**Introduction to Data structure and Algorithms** Introduction, Data Structure, Types, ADT, Design of Algorithms, Performance Analysis, Recurrence Equations: Solution of Recurrence Equations–Iteration Method and Recursion Tree Methods, Towers of Hanoi	4

II	**Linked Lists** Concept of linear data structure, Singly linked list, doubly linked list, circular linked list, Operations such as insertion, deletion, inversion, concatenation, computation of length, traversal on linked list, Representation of polynomials using linked lists.	5
III	**Stacks and Queues** Fundamentals of stack and queue as ADT, Representation and Implementation of stack and queue using sequential and/or linked organization, Types, Application of stack and queue	4
IV	**Tree and Graph** Basic concepts, representation of tree and graph in memory, traversal, applications	5
V	**Divide and Conquer Method** Binary Search, Merge Sort, Quick sort, Multiplication of Large Integers, Convex Hull Problems, Strassen's Matrix Multiplication.	4
VI	**Greedy Method** Minimum Cost Spanning Trees, Job Sequencing with deadlines, Knapsack Problem, Huffman Trees.	4
		Total Hrs : 26

List of Laboratory Experiments/ Practicals (if applicable)

1. Problems based on memory management, array, pointers and structures.
2. Implementation of different operations on linked lists.
3. Implementation of stack and its operations.
4. Implementation of queue and its operations.
5. Applications of stack and queue.
6. Implementation of Tree and graph.
7. Implementation of Tree and Graph traversal.
8. Applications of Tree and Graph.
9. Implementation of searching and sorting techniques.
10. Multiplication of Large Integers.
11. Job Sequencing with deadlines.

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz	Based on concepts studied during class	**10**	**5**	**3**
	2	Assignment	Implementation of stack, queue and linked list	**10**	**15**	**4**
MSE	**3**	Story building	Creating visual story for certain real time application using	**15**	**10**	**6**

			appropriate data structure			
	4	Assignments/Open Book Exam	Critical scenario based problems on Stack, Queue, linked list	**15**	**10**	**7**
ESE	**5**	Case Study based problem: implementation and Presentation	Implementation and presentation of a solution for assigned real time problem, including its design using appropriate data structure and its implementation along with outcome	**30**	**15**	**11**
	6	Oral/Viva		**20**	**5**	**12**
			Total	**100**	**60 hrs**	

Text Books	
1	Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures, A Pseudocode Approach With C",Cengage Learning, Second Edition, 2014
2	S. Lipschutz, "Data Structures,Schaum's" Outlines Series, Tata McGraw-Hill, 2013
3	Ellis Horowitz, Sartaj Sahni and Rajasekaran "Fundamentals of Computer Algorithms" , Galgotia Publications, 2nd Edition.
References	
1	Goodman, "Introduction to Design and Analysis of Algorithm", McGraw Hill.
2	Jean-Paul Tremblay, Paul. G. Soresan, "An introduction to data structures with Applications", Tata Mc-Graw Hill International Editions, 2nd edition, 1984
3	Thomas H. Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein "Introduction to Algorithms" Third Edition, 2009,The MITPress Cambridge.
Useful Links	
1	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
2	https://www.coursera.org/learn/data-structures
3	https://www.ebooks.com/en-in/book/1679384/algorithms-design-techniques-and-analysis/m-h-alsuwaiyel

7MD275 Elements of Mechanical Engineering 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Mechanical Engineering
Class, Semester	Second Year B. Tech. SEM-I
Course Code	7MD275
Course Name	Elements of Mechanical Engineering
Desired Requisites:	NA

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1	To engage students in analysing mechanisms used in Mechanical Engineering
2	To prepare the students for applying concepts of motion transmission using mechanisms and gears
3	To make students aware about thermal engineering concepts.

Course Outcomes (CO)

At the end of the course, the students will be able to,

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Define the fundamental concepts of thermodynamics, manufacturing processes, and list the various components of thermal systems, power plants, and mechanical drives.	Remembering	I
CO2	Explain the working principles of internal combustion engines, refrigeration systems, power transmission devices, and describe the properties of engineering materials.	Understanding	II
CO3	Apply the First Law of Thermodynamics to solve numerical problems regarding heat/work interaction and calculate velocity ratios, gear ratios, and belt tensions in mechanical transmission systems.	Applying	III
CO4	Analyze the stress-strain behavior of materials under load, compare the performance of different power plants (thermal, hydro, nuclear, solar), and distinguish between various manufacturing and joining processes for specific applications.	Analysing	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2				2	2				
CO2	3	2	2			2	2				
CO3	3	3	2								
CO4	2	3	2			2	2				

Module	**Module Contents**	**Hours**

I	**Basic Thermodynamics**: Introduction, thermodynamic state, process, cycle, thermodynamic system, heat, work, internal energy, first law of thermodynamics, application of first law, introduction to heat engine, heat exchangers: types, simple numericals on first law of thermodynamics.	5
II	**Thermal Systems:** Introduction, pumps, compressors, turbines, refrigeration system, air conditioning systems, two-stroke, four-stroke engines, fuel injection, E-vehicles	5
III	**Conventional and Non-Conventional Energy Generation Systems:** Introduction, Need and comparison, thermal power plants, hydropower plants, wind power plants, solar, nuclear power plant, energy from domestic and industrial waste.	5
IV	**Mechanical Properties of Metals**: Concepts of stress, strain and strength, stress-strain curves, fracture - ductile and brittle fracture, thermal, electrical and magnetic properties of materials, composites, advanced materials	5
V	**Power Transmission**: Need, belt drives, chain drives, and gear drives, (numerical on belt tensions, gear ratio, and velocity ratio), couplings, and their types, clutch and brake, bearings, CVT transmission	5
VI	**Manufacturing Processes**: Introduction to manufacturing processes - casting process, steps involved in casting processes, and their applications, metal removing processes - lathe, milling and drilling operations, metal joining - arc welding, soldering, brazing and their applications, laser machining, 3-D printing.	5
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Assignments	Numerical Problem Solving: Focus on First Law of Thermodynamics, Heat, Work, and Internal Energy (Module 1)	10	6	3
	2	Digital Poster Making	Comparative study of Manufacturing Process (Module 6).	10	6	12
MSE	3	Quiz	Based on Module 1, 2 and 3	20	12	6
	4	Group Discussion	Based on Module 1, 2 and 3	10	6	7
ESE	5	Seminar	Based on Module 4 and 5	20	12	10
	6	Viva Exam	Based on Module 6	10	6	12
	7	Open Book Test	Comprehensive assessment covering all Modules (1 to 6)	20	12	13
			Total	**100**	**60 hrs**	

Text Books

1	Materials Science and Engineering, William D. Callister, Wiley India, 9th edition, 2022
2	V.B. Bhandari, Design of Machine elements, Tata Mc-Graw Hill, 5th Edition, 2022
3	R, Yadav, Applied Thermodynamics, Central Publishing House, 3rd Edition, 2011

References

1	Den Hartog, Jacob P., Strength of Materials. Dover Publications Inc., 3rd Ediдtion 1961
2	Yunus A Cengel and Michael Boles, Thermodynamics: An engineering approach, McGraw Hill, 9th Edition, 2015

Useful Links

1	https://archive.nptel.ac.in/courses/112/104/112104188/
2	https://www.youtube.com/watch?v=kC2SEiGaqoA
3	https://nptel.ac.in/courses/112104304

7MD276 Modern Built Environment 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Civil Engineering
Class, Semester	SY B. Tech. Semester IV
Course Code	7MD276
Course Name	Modern Built Environment
Desired Requisites:	Basic Civil Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

To introduce students to the fundamentals of site selection, building planning, construction systems, building materials, and building drawings, and to create awareness about smart and green building concepts for safe, efficient, and sustainable built environment practices.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the categories of buildings, site selection factors, planning principles, and types of building drawings used in civil engineering practice.	Understanding	II
CO2	Construct basic residential and public building plans using standard planning principles, symbols, orientation, and relevant scales.	Applying	III
CO3	Identify and differentiate building components, foundations, construction systems, and common building materials based on their properties and applications.	Analysing	IV
CO4	Apply basic concepts of smart buildings and green buildings for improving safety, energy efficiency, and sustainability in the built environment.	Applying	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	1									
CO2	2	2			2						1
CO3	2	2									
CO4	2	2									1

Module	Module Contents	Hours
I	Site, Building and Building Drawings Categories of buildings, Types of Residential buildings, Site selection, Factors influencing selection of site, guidelines for planning and drawing of buildings, Positions of various building components, types of drawings and relevant scales.	6

II	Principles of Building Planning and concepts Principles of planning, Requirements in different types of buildings, Integrated approach to planning in various aspects like aesthetics, landscape, interior, etc. Guidelines for planning & drawing residential and public buildings.	5
III	Building Components & Construction Systems Sub structure, Foundations, Bearing Capacity of Soils, Types of Shallow and Deep foundations, Conditions for their applications, masonry, Bonds, Doors, Windows, Staircases, Roofs and Floors, Flooring and their Applications	5
IV	Building Materials Types, Engineering properties and Uses of Bricks, Stones, Aggregate, Lime, Cement, Steel, Aluminium, PVC, Glass. Concrete: Ingredients, Preparation, Properties of concrete, Types of concrete and their applications	4
V	Smart Building Concepts & Dimensions Concepts, IoT in buildings, Dimensions, Greenness, Safety: Electronic Access Control, CCTV Surveillance, Fire Safety, Productivity: Building Management System, Building Automation Systems.	5
VI	Concept of Green Buildings Sustainable development concepts, green building initiatives, its origin, characteristics of a green building, green buildings in India, Certification of green buildings, sustainability criteria and life cycle thinking.	5
		Total Hrs: 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz using Online Tools	Quick assessment of conceptual understanding of planning norms, components, and soil–foundation basics.	10	2	
	2	Design of Experiment	Simple experimental planning for soil testing or material testing to understand construction behaviour.	10	3	
MSE	**3**	Drawing / Planning Exercise	Preparation of a basic building plan (residential/public) with proper orientation, zoning, and relevant scales. Evaluates practical application of planning and drawing concepts	15	10	
	4	Digital Poster / Technical Sketch & Presentation	prepare and present digital sketches of foundations, building components, staircases, etc	15	10	
ESE	**5**	Seminar / Case Study Presentation	Presentation on a short case study on smart buildings, green buildings, or modern construction systems. Assesses communication skills and application to real-world scenarios.	25	25	

	6	Report on Lab/Industry Visit –	Report based on site visit to a construction project or material testing laboratory.	25	10	
			Total	**100**	**60 hrs**	

Text Books	
1	R.K.Rajput S. 'Building Materials' S. Chand Publications
2	Kumarswamy and Kameshwar Rao., "Building Planning and Design," Tata McGraw Hill Pvt.
3	Bindra and Arora, "Building Construction", Dhanpat Rai and Sons
4	"Internet of Things – A hands-on approach", Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
References	
1	Building drawing with Integrated approach – Shah, Kale & Patki, Tata Mc Graw Hill Pub.
2	Robert Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Construction Planning, Equipment and Methods, McGraw Hill Education, 7th edition, 2010
3	Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham Mahmood
4	Mantri Institute's 'The A to Z of Practical Building Construction and its Management' Mantri Institute of Devp. and Research. Pune, 1994.
Useful Links	
1	https://www.youtube.com/watch?v=yel5lS4ioFE&list=PLL7liBDYa4YbmpO2Vv-9jwcz1pzJlIcFn
2	https://www.youtube.com/watch?v=ToIr806i0Sw

28. Course Content for Semester V

7MD311 V IoT, Cloud and Edge Communication Protocols 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	MDM in Communication System and Networks
Class, Semester	Third Year B. Tech., Sem-I
Course Code	7MD311
Course Name	IoT, Cloud & Edge Communication Protocols
Desired Requisites:	-

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Understand the multi-tier architecture of IoT, spanning from perception (sensors/actuators) to the edge, fog, and cloud computing environments.
2. Comprehend the role, constraints, and functionalities of physical devices, gateways, and centralized servers.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Describe the architecture, components, and communication requirements of IoT systems, including IoT devices, sensors, gateways, cloud, fog, and edge computing paradigms.	Understand	II
CO2	Analyze and compare IoT networking and connectivity technologies	Analyze	III
CO3	Evaluate IoT application-layer protocols and cloud communication frameworks.	Evaluate	V
CO4	Implement secure IoT solutions to address real-world application challenges through case-study-based analysis.	Create	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1		2		2							
CO2			3		2						
CO3	3			3	3						
CO4	2	2									

Module	Module Contents	Hours
I	**Introduction to IoT and Communication Architecture** Evolution of IoT, IoT Ecosystem and Architecture, IoT Layers and Reference Models, IoT Devices, Sensors, Actuators, and Gateways, Cloud Computing and Edge Computing Concepts, Fog Computing Architecture, Challenges in IoT Communication	**5**

II	**IoT Network and Connectivity Protocols** IoT Communication Requirements, Wired Communication Technologies Ethernet: RS-232/RS-485, Short-Range Wireless Protocols: Wi-Fi (IEEE 802.11), Bluetooth and Bluetooth Low Energy (BLE), ZigBee (IEEE 802.15.4), Z-Wave, NFC and RFID, LPWAN Technologies: LoRaWAN, Sigfox	**5**
III	**IoT Application Layer Protocols** Protocol Stack in IoT, MQTT Architecture and Message Exchange, MQTT QoS Levels, MQTT-SN, CoAP Protocol, RESTful Communication, HTTP/HTTPS for IoT, AMQP Protocol, XMPP Protocol, DDS (Data Distribution Service), Protocol Comparison and Performance Analysis	**6**
IV	**Cloud Communication and Data Management** Cloud Computing Fundamentals, IoT Cloud Platforms, Device-to-Cloud Communication, Cloud Data Storage and Processing, Cloud APIs and Web Services, Real-Time Data Streaming, Event-Driven Architecture.	**4**
V	**Edge Computing and Security Protocols** Edge Computing Architecture, Edge Analytics, Edge Gateway Functions Device-to-Edge Communication, Edge AI and Real-Time Processing Security Requirements in IoT	**5**
VI	**Case Studies** Analysis of real-world IoT, Cloud, and Edge Computing applications, Review of emerging trends, standards, and best practices in IoT communication ecosystems, Preparation and presentation of case studies based on smart city, healthcare, industrial automation, agriculture, transportation, energy, and environmental monitoring applications.	**5**
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Assignments	IoT Devices, Sensors, Actuators, and Gateways, Cloud Computing and Edge Computing Concepts,	15	8	3
	2	Article Discussion	IoT Cloud Platforms, Device-to-Cloud Communication	5	2	4
MSE	3	Short Quiz/ MCQ Test	IoT, Cloud and Edge computing protocols	20	10	6
	4	Seminar	Case Studies	10	5	8
ESE	5	Quiz/ MCQ Test	IoT, Cloud and Edge computing protocols	30	20	12
	6	Mini Project	Case Studies in the field of emerging trends	10	10	13
	7	Oral/ Viva Exam	IoT Network and Connectivity Protocols and architecture	10	5	14
	8……..					
	Total			**100**	**60hrs**	

Text Books

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017
2	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
3	Rajkamal,"Internet of Things: Architecture, Design Principles And Applications", McGraw Hill, HigherEducation
4	
References	
1	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols, Wiley, 2012
2	Michael J. Kavis, Architecting the Cloud: Design Decisions for Cloud Computing Service Models, Wiley, 2014.
3	Olivier Hersent, David Boswarthick, and Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 3rd Edition, 2021.
Useful Links	
1	https://nptel.ac.in/courses/106105166?utm
2	https://nptel.ac.in/courses/106105167?utm
3	https://nptel.ac.in/courses/106104449?utm

7MD312 V Semiconductor Material and Device Characterization 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	MDM in Semiconductor Technology
Class, Semester	Third Year B. Tech., Sem-I,
Course Code	7MD312
Course Name	Semiconductor Material and Device Characterization
Desired Requisites:	Solid State Electronic Devices

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

5. To understand the types of defects in semiconductor materials and devices.
6. To equip students with the skills to perform and interpret various characterization techniques.
7. Learning about various growth and fabrication techniques of semiconductor materials and devices.
8. To prepare students for the rapidly evolving field of semiconductor technology by exposing them to current trends, cutting-edge research, and emerging applications.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**Identify** and analyze various types of defects in semiconductor materials and understand their effects on device reliability and lifetime.	Understand	II
CO2	**Demonstrate** the skills in electrical measurement of semiconductor materials.	Apply	III
CO3	**Analyze** the quality of metal contacts and electrical performance of FET devices.	Analyze	IV
CO4	**Demonstrate** the skills in optical characterization of semiconductor materials and special device structures.	Apply	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1		3		2							
CO2		3	3		2						
CO3	3	3		3							
CO4	3	2									

Module	Module Contents	Hours
I	**Characterization of Defects and Impurities in Semiconductors** Defects and impurities in silicon materials–Metal contaminants in Si wafers, Shallow-level and deep-level impurities, Impurity diffusion and precipitation, Impact of defects and impurities on materials properties and device performance, Failure mechanism.	**6**

II	**Electrical Characterization of Semiconductor Materials** Electrical resistivity – Definitions and units, Resistivity measurement by four-point probe and Eddy current techniques, Resistivity profiling, Hall effect and carrier mobility measurements, Carrier and doping density measurements by capacitance-voltage and Hall measurements.	**6**
III	**Electrical Characterization of Semiconductor Devices** Metal/semiconductor contacts–various measurement geometries, barrier height and contact resistance measurements, Measurement of FET channel parameters, Field-effect mobility, Measurement of oxide and interface parameters in MOS devices, Wafer probing.	**6**
IV	**Optical Characterization Methods** Optical absorption and bandgap measurement, Photoluminescence, Optical microscopy, Ellipsometry, Carrier lifetime analysis by time-resolved spectroscopy, Raman Spectroscopy.	**6**
V	**Chemical and Physical Characterization** Electron Beam Techniques, Ion Beam Techniques, Electron Beam, Ion Beam and X-Ray Methods, X-Ray and Gamma-Ray Techniques.	**3**
VI	**Reliability and Failure Analysis** Failure Times and Acceleration Factors, Reliability Concerns, Failure Analysis Characterization Techniques.	**3**
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Assignments**	Module Nos. I to IV	**15**	**8**	**3, 10**
	2	**Article Discussion**	characterization of semiconductor material and devices	**5**	**2**	**4**
MSE	**3**	**Short Quiz/ MCQ Test**	Electrical characterization of semiconductor material and devices	**20**	**10**	**6**
	4	**Seminar**	Methods to evaluate the quality of semiconductor material and devices	**10**	**5**	**8**
ESE	**5**	**Quiz/ MCQ Test**	Optical, chemical and physical characterization methods	**30**	**20**	**12**
	6	**Mini Project**	Reliability and Failure Analysis of semiconductor devices	**10**	**10**	**13**
	7	**Oral/ Viva Exam**	To evaluate the understanding of characterization of semiconductor material and devices	**10**	**5**	**14**
	8……..					
			Total	**100**	**60 hrs**	

Text Books

1	Dieter K. Schroder, “Semiconductor Material and Device Characterization”, “John Wiley & Sons, Inc.”, 3rd Edition, 2006.
2	Y. Yoshida and G. Langouche, “Defects and Impurities in Silicon Materials”, “Springer”, 2015.

3	Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 4th Edition, McGraw Hill Higher Education, 2012.
4	K. Abbas, "Handbook of Digital CMOS Technology, Circuits, and Systems", "Springer", 1st Edition., 2020.
References	
1	S. M. Sze and M. K. Lee, "Semiconductor Devices: Physics and Technology", 3rd Edition., John Wiley & Sons Inc., 2012.
2	Peter Y. Yu and M. Cardona, "Fundamentals of Semiconductors: Physics and Materials Properties", "Springer-Verlag Berlin", 4th Edition., 2010.
3	D. Nagchoudhuri, "Microelectronic Devices", PHI, 2002
Useful Links	
1	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mm26
2	https://www.coursera.org/specializations/semiconductor-characterization#courses
3	https://ocw.mit.edu/courses/6-780-semiconductor-manufacturing-spring-2003/
4	www.youtube.com/watch?v=G41t_0CqPzY&list=PLbMVogVj5nJTqQc4Takon3QAhrtOLBV4M
5	www.youtube.com/watch?v=EJoUQP-5g7g&list=PLbMVogVj5nJRbajyOAp_GHxTW9tQEqd0W
6	www.youtube.com/watch?v=uzRprAA9Ci0&list=PLbMVogVj5nJSqDpNX98GttEel31r8-R-o

7MD318 3 **V** **Digital Forensics & Incident Response** **2** **0** **1** **0**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Cyber security and Digital Forensics
Class, Semester	Third Year, Sem-V
Course Code	7MD318
Course Name	Digital Forensics & Incident Response
Desired Requisites:	Cybersecurity Essentials

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To understand the fundamental concepts of digital forensics, cybercrime investigation, and incident response processes.
2. To develop the ability to acquire, preserve, and analyze digital evidence using forensic methodologies and tools.
3. To investigate security incidents through host, network, and malware forensic analysis techniques.
4. To apply incident response procedures and prepare professional forensic reports for effective cyber incident management.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Explain digital forensic principles, evidence handling procedures, and cyber investigation methodologies.	Explain	L2
CO2	Demonstrate the ability to acquire, preserve, validate, and examine digital evidence using appropriate forensic techniques and tools.	Demonstrate	L3
CO3	Investigate cyber incidents using host, network, and malware forensic techniques to identify indicators of compromise and attack patterns.	Investigate	L4
CO4	Implement incident response procedures to detect, contain, eradicate, recover from, and document cybersecurity incidents in organizational environments.	Implement	L3

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2		1			2				
CO2	3	3		2	3						
CO3	2	3		3	3			1			
CO4		3	2		2			2	3		2

Module	**Module Contents**	**Hours**

I	**Foundations of Digital Forensics and Cyber Investigations** Introduction to Digital Forensics, Cybercrime Investigation Process, Types of Digital Evidence, Chain of Custody, Evidence Preservation, Legal and Ethical Considerations, Cybercrime Case Studies, Forensic Readiness, DFIR Frameworks and Standards	5
II	**Evidence Acquisition and Data Recovery** Sources of Digital Evidence, Static and Live Acquisition, Memory Acquisition Fundamentals, Disk Imaging Techniques, Forensic Duplication, Hashing and Integrity Verification, File System Analysis (FAT, NTFS, EXT), Data Recovery Techniques, Introduction to Autopsy and FTK Imager	5
III	**Endpoint and Mobile Forensics** Windows Forensics Fundamentals, Linux Forensics Fundamentals, User Activity Analysis, Registry Analysis, Event Log Analysis, Browser and Email Forensics, Deleted File Recovery, Timeline Analysis, Indicators of Compromise, Mobile Device Forensics Fundamentals, Android Forensics, iOS Forensics, Mobile Application Artifacts, Mobile Communication and Messaging Analysis, Cloud-Synchronized Mobile Evidence	5
IV	**Network and Cloud Forensics** Network Forensics Fundamentals, Packet Capture Techniques, Network Traffic Analysis, Log Collection and Correlation, Firewall Logs, IDS/IPS Logs, Web Server Logs, Wireshark Fundamentals, Detection of Suspicious Network Activities, Cloud Forensics Fundamentals, Cloud Log Analysis, Cloud Incident Investigation Challenges	5
V	**Malware Analysis and Threat Hunting** Malware Fundamentals, Malware Classification, Static and Dynamic Malware Analysis Concepts, Malware Artifacts, Threat Intelligence Fundamentals, Indicators of Attack and Indicators of Compromise, Attack Timeline Reconstruction, Ransomware Investigation, Threat Hunting Fundamentals, MITRE ATT&CK Framework	5
VI	**Incident Response, SOC Operations and AI-Assisted DFIR** Incident Response Lifecycle, Preparation Phase, Detection and Analysis, Incident Classification, Containment Strategies, Eradication Procedures, Recovery Techniques, Root Cause Analysis, Incident Documentation, Forensic Reporting, Security Operations Center (SOC) Workflow, SIEM Concepts, Digital Forensics in Enterprise Environments, AI-Assisted Incident Response, Generative AI in Cyber Investigations, Emerging Trends in DFIR	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment-Based Continuous Assessment	Two assignments based on forensic investigation, log analysis, malware investigation, evidence acquisition, and incident response case	**20**	**12**	**5,7**

			analysis (10 marks each)			
MSE	**2**	Mini Project and Case Study Analysis	Students perform a guided DFIR investigation involving evidence collection, forensic analysis, attack reconstruction, and preparation of an investigation report based on a given cyber incident scenario.	**30**	**18**	**8**
ESE	**3**	Comprehensive Written Examination	Descriptive and case-based examination covering all modules with emphasis on digital evidence analysis, network forensics, malware investigation, and incident response strategies.	**50**	**30**	**13**
			Total	**100**	**60 hrs**	

Text Books	
1	**Bill Nelson, Amelia Phillips, Christopher Steuart**, *Guide to Computer Forensics and Investigations*, 6th Edition, Cengage Learning.
2	**Jason T. Luttgens, Matthew Pepe, Kevin Mandia**, *Incident Response & Computer Forensics*, 3rd Edition, McGraw-Hill.
3	**Eoghan Casey**, *Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet*, 3rd Edition, Academic Press.
References	
1	**Brian Carrier**, *File System Forensic Analysis*, Addison-Wesley
2	**Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters**, *The Art of Memory Forensics*, Wiley
3	**Chris Sanders**, *Practical Packet Analysis Using Wireshark to Solve Real-World Network Problems*, 3rd Edition
Useful Links	
1	NIST CSRC – https://csrc.nist.gov
2	SANS DFIR Resources – https://www.sans.org/cybersecurity-focus-areas/digital-forensics-incident-response
3	CISA Cybersecurity Resources – https://www.cisa.gov

7MD320 V Mechanization in Agriculture 2 0 1 0 3

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2026-27 onwards					
Course Information					
Programme	MDM in Agritech				
Class, Semester	Third Year - B. Tech., Sem. V				
Course Code	7MD320				
Course Name	Mechanization in Agriculture				
Desired Requisites:					

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Understand the principles, concepts, and applications of agricultural mechanization in modern farming systems.
2. Study the construction, operation, and maintenance of farm machinery used for various agricultural operations.
3. Analyze the performance of agricultural machines and evaluate their suitability for different farming conditions.
4. Explore recent developments and innovations in agricultural mechanization and precision agriculture.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Equip students with theoretical knowledge and conceptual skills needed to undertake professional tasks in the Agricultural Mechanization.	II	Understand
CO2	Develop capacities of students to conduct research in new developmental trends in the Agricultural Mechanization.	II	Understand
CO3	Design machine components and systems for different agriculture processes	III	Apply
CO4	To develop skills in the students required to develop and modification of indigenous farm machines as per the need of the area and farmers	IV	Analyse

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	1		2	1	1				
CO2	2	3	1	3	2	1	2		1	1	
CO3	3	2	3	2	3	1	1		1	1	2
CO4	2	3	3	2	3	2	3	1	2	1	2

Module	**Module Contents**	**Hours**

I	**Introduction to Agricultural Mechanization** Concept and Importance of Agricultural Mechanization, Advantages and Limitations of Mechanization, Levels of Agricultural Mechanization, Impact of Mechanization on Farm Performance, Mechanization for Modern Agriculture, Sources of farm power, Classification of agricultural machinery, Selection criteria for farm machinery, Economics of mechanization (*ownership and operating cost*)	5
II	**Land Preparation and Seedbed Machinery** Introduction to land and Seedbed Preparation, Objectives and principles of tillage; primary and secondary tillage; tillage implements; seedbed preparation machinery; conservation tillage and minimum tillage concepts; selection and operation of tillage and seedbed preparation equipment.	5
III	**Sowing, Planting and Nutrient Application Machinery** Fundamentals of sowing and planting; seed sowing machinery; seed drills and precision planters; specialized planting machinery; planting and transplanting machinery; fertilizer application equipment; organic manure application machinery; calibration of seed and fertilizer application equipment.	5
IV	**Intercultural Operations, Plant Protection and Irrigation Mechanization** Intercultural operations; mechanical weeding and inter-cultivation equipment; principles of plant protection; sprayers and dusters; selection and operation of plant protection equipment; safety during pesticide application; maintenance of spraying equipment; irrigation mechanization and equipment used for efficient water application.	5
V	**Harvesting, Threshing and Post-Harvest Machinery** Principles of harvesting; manual and mechanical harvesting; reapers; combine harvesters; fruit and horticultural harvesting tools and machinery; threshers; cleaning and grading equipment; drying systems; storage considerations; post-harvest mechanization.	5
VI	**Modern Agricultural Mechanization and Farm Machinery Management** Farm machinery management: selection, operation, maintenance, testing and evaluation of farm machinery; repair and replacement planning; ownership versus hiring decisions; life-cycle cost analysis. Testing and certification of agricultural machinery; role of Farm Machinery Training and Testing Institutes (FMTTIs) in performance testing and quality assurance; economic and sustainability assessment of farm mechanization; case studies of farm mechanization.	5
		Total Hrs: 30
Course Assessment Plan (*for total 60 learning hours)*		

Assessment						
Assessment No.		**Formative Assessment type**	**Brief Description**	**Marks**	**Notional Learning hours**	**Week**
ISE	1	Quiz, Crossword etc. using online tools	Continuous Assessment, Knowledge Check, application of basics and analytical skill	10	10hrs	Throughout course
	2	Assignments		10	10hrs	Throughout course
MSE	3	Open Book Exam	Suitable for evaluating comprehension, analysis, synthesis, and evaluation rather than rote learning.	15	10hrs	Week 9
	4	Group Discussion	Content Relevance and Knowledge, Team Interaction and Collaboration	15	10Hrs	Week 10
ESE	5	Case Study Presentations/ Debating	Analyzing a complex real-world PA implementation and presenting findings/arguments).	30	10 hrs	Weeks 12–13
	6	Oral/Viva Exam	(Assessing conceptual clarity, project knowledge, and communication skills).	20	10hrs	Week 14-15
Total				**100**	**60 hrs**	**15**

Text Books	
1	Principles of Agricultural Engineering (Vol 1) by A. M. Michael & T. P. Ojha
2	Fundamentals of Agricultural Engineering by Er. Sanjay Kumar et. al.
3	Elements of Agricultural Engineering by Dr. Jagdishwar Sahay
4	Sharma, D. N. & Mukesh, S. (2013). Farm Machinery Design Principles and Problems (3rd ed.). New Delhi: India. Jain Brothers

References	
1	Bernacki, H., Haman, J., & Kanafojski, C. (1972). Agricultural Machines Theory and Construction, Volume 1. Virginia, USA: U.S. Dept. of Commerce, National Technical Information Service.
2	Bosoi, E.S., Verniaev, O.V., Smirnov I. I., & Sultan-Shakh, E.G. (1990). Theory, Construction and Calculations of Agricultural Machinery - Vol.-I. New Delhi, India: Oxonian Press Pvt.
3	Gill, R., & Vanden Berg, G. E. (2013). Soil Dynamics in Tillage and Traction. New Delhi, India: Scientific Publishers.

Useful Links	
1	https://nptel.ac.in/courses/126105009
2	https://nptel.ac.in/courses/126105547

7MD321 V Sustainable Electronics 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	MDM in Sustainability
Class, Semester	Third Year B. Tech., Sem-I
Course Code	7MD321
Course Name	Sustainable Electronics
Desired Requisites:	-

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Enable the students to describe ecological, economic, and social impacts associated with electronics manufacturing, usage, and disposal.
2. Enable the students to apply eco-design tools, sustainability metrics and tools to create environmentally responsible electronics.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the environmental impacts associated with electronic product lifecycles, including materials, energy use, and end-of-life issues.	Understand	II
CO2	Apply eco-design principles such as design for disassembly, modularity, recyclability, and reduced material usage to electronic systems.	Apply	III
CO3	Analyze electronics products using LCA tools.	Analyze	IV
CO4	Design and propose sustainable electronic product concepts or system-level solutions that minimize environmental impact across the lifecycle.	Create	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2		2			3				
CO2		3	3		2	3	3				
CO3	3	3		3	3		3				
CO4	2	2	3			3	3				

Module	Module Contents	Hours
I	**Introduction to Sustainable Electronics** Concepts of sustainability and circular economy, Environmental impact of traditional electronics, Global e-waste statistics and regulations (RoHS, WEEE, EPR), Life-cycle thinking: cradle-to-grave vs cradle-to-cradle, Green design strategies for electronic products, Case studies of sustainable tech companies	**5**

II	**Material and Energy Optimization Strategies in Electronics Products** **Material Optimization:** Overview of electronic materials and their environmental footprint, Eco-friendly materials: bioplastics, biodegradable substrates, Rare earth metals: challenges in mining and recycling, Conductive polymers and organic electronics, Toxicity issues of solder, batteries, semiconductors. **Energy Optimization:** Low-power electronics: principles and techniques, Power management in IoT devices and embedded systems, Energy harvesting (solar, thermal, kinetic), Energy-efficient semiconductor manufacturing.	**6**
III	**Principles of Eco-Design** Design for Environment(DfE): Minimizing ecological footprint through smarter design, Integrating environmental criteria early in product development Design for Sustainability(DfS): Balancing environmental, economic, and social aspects. Cradle-to-Cradle (C2C) design concepts: Closed-loop material cycles, eliminating waste by rethinking product systems, Life Cycle Thinking: Design choices based on manufacturing, use, disposal impacts	**5**
IV	**Methods and Tools for Eco-Design** Life Cycle Assessment (LCA): Assessing environmental impacts from raw material extraction to disposal, Use of tools like SimaPro, GaBi, OpenLCA Material Flow Analysis (MFA): Tracking material flows in product systems Environmentally Conscious Quality Function Deployment (Eco-QFD): Integrating environmental requirements with customer needs Design for X (DfX): DfR- Design for Repair, DfM- Design for Manufacturing, DfA- Design for Assembly, DfU- Design for Upgradability	**5**
V	**Electronic Waste (E-Waste) Management & Recycling** E-waste generation, composition, hazards, Safe dismantling and recycling processes, Recovery of metals, plastics, rare earths, Reverse logistics for electronics, Repair, refurbishment, remanufacturing in circular economy, Case studies: India's e-waste rules, global best practices	**4**
VI	**Future Trends and Innovation in Sustainable Electronics** Flexible, organic, and printed electronics, Wearable eco-friendly devices, Green data centres & sustainable computing, AI/ML for sustainability: predictive maintenance & waste reduction, Policy, standards, and global initiatives, Industry 4.0 & sustainability integration	**5**
		Total Hrs : 30
Course Assessment Plan (***for total 60 learning hours)***		

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Assignments	Concepts of sustainability and circular economy	15	8	3
	2	Article Discussion	Methods and Tools for Eco-Design, Electronic Waste (E-Waste) Management & Recycling	5	2	4
MSE	3	Short Quiz/ MCQ Test	Principles of Eco-Design	20	10	6
	4	Seminar	Methods and Tools for Eco-Design, Electronic Waste (E-Waste) Management & Recycling	10	5	8
ESE	5	Quiz/ MCQ Test	Material and Energy Optimization Strategies in Electronics Products	30	20	12
	6	Mini Project	Future Trends and Innovation in Sustainable Electronics	10	10	13
	7	Oral/ Viva Exam	Electronic Waste (E-Waste) Management & Recycling	10	5	14
		Total		**100**	**60hrs**	

Text Books	
1	Joseph Fiksel , "Design for Environment: A Guide to Sustainable Product Development", McGraw-Hill Professional, 2nd Edition (2011)
2	Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the Environment: A Life Cycle Approach", CRC Press (Taylor & Francis), 1st Edition (2006)
3	Janis Birkeland, "Design for Sustainability: A Step-by-Step Approach", Routledge Publications.
4	
References	
1	Farkhanda Ana, Sandeep Arya & Haider Mehraj, "Sustainable Electronics: The Future Ahead", CRC Press, 1st Edition, 2025
2	Sammy G. Shina, "Green Electronics: Design and Manufacturing – Implementing Lead-Free and RoHS-Compliant Global Products", McGraw-Hill Professional, 1st Edition, 2008
3	Jo Dewulf & Herman Van Langenhove, "Handbook of Sustainable Engineering", Springer, 1st Edition, 2014.
Useful Links	
1	https://nptel.ac.in/courses/105105169
2	https://onlinecourses.nptel.ac.in/noc21_ce47
3	https://onlinecourses.nptel.ac.in/noc22_me61

7MD322 V Digital Twin and Robotics 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Industry 4.0
Class, Semester	T Y B.Tech., V
Course Code	7MD322
Course Name	Digital Twin and Robotics
Desired Requisites:	NA

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Develop and analyse digital twins of industrial assets and processes
2. Simulate and optimize manufacturing and material flow systems
3. Integrate industrial robotics with automation systems
4. Apply AR/VR technologies for digital visualization and training

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**To understand** the fundamental concepts of digital twins, system simulation, industrial robotics, and mechatronics used in smart manufacturing.	Understanding	I
CO2	**To Explain** the working principles of digital twin architectures, discrete-event simulation, robotic manipulators, and Industry 4.0 mechatronic systems.	Explaining	II
CO3	**To Apply** digital modeling, system simulation, and basic robotic automation techniques to solve elementary manufacturing system problems.	Applying	III
CO4	**To Analyse** digital twin–based manufacturing systems using simulation, robotic cell performance, and process data to identify bottlenecks and performance limitations.	Analysing	IV

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	1	–	–	2	–	–	–	–	–	–
CO2	2	2	1	–	2	–	–	–	–	1	–
CO3	2	2	3	1	3	–	–	–	2	–	1
CO4	2	3	2	3	3	–	–	–	1	2	–

Module	Module Contents	Hours
I	**Introduction to Digital Twins** Digital replicas, Kinematics, loads, wear modelling basics, Benefits in automotive, aerospace, manufacturing	5

II	**System Simulation** Discrete event simulation (lines, cells), Flow simulation (material movement), Throughput & bottleneck analysis	5
III	**Robotics for Industrial Tasks** Manipulators used in welding, assembly, machining, EOAT (end-of-arm tooling) concepts, Robot + conveyor sync	5
IV	**Mechatronics for Industry 4.0** Electro-mechanical actuators, Pneumatic & hydraulic automation, Sensors–motors–controllers integration	5
V	**Process Digital Twins** Twinning of machining operations (cutting, pressing), Twinning of rotating machinery, Real-time monitoring of tool wear	5
VI	**AR/VR for Visualization** AR for maintenance, VR assembly and disassembly training, Parts visualization	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Think Pair Share (TPS) activity	On module I, II and III	10	5I + 5SL	Week 3
	2	Peer assessment Self-assessment	On Module IV, V and VI	10	5I + 5SL	Week 10
MSE	**3**	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module I-III	15	10 SL	Week 8
	4	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module IV-VI	15	10 SL	Week 15
ESE	**5**	Exam Online (Preferred) / Offline	40% weightage on modules I to III and 60% weightage on modules IV to VI.	50	20 SL	Week 16
			Total	**100**	**60 hrs**	

Text Books

1	Digital Twin for Smart Manufacturing: Emerging Approaches and Applications by Rajesh Kumar Dhanaraj, Ali Kashif Bashir (Editors), Academic Press, Elsevier2023
2	Mechatronics for Complex Products and Systems: Project-Based Design Approaches for Robots, Cyber-Physical Systems, Digital Twins, and Other Emerging Technologies by Zhuming Bi, John Wiley & Sons2025
3	Industrial Robotics: Programming, Simulation and Applications by Kin-Huat Low (Editor), InTech Publishing2007

Reference Books

1	Springer Handbook of Robotics
2	**Simulation Techniques of Digital Twin in Real-Time Applications** — Edited by Abhineet Anand et al. (2024)
3	**Robotics, Mechatronics and Manufacturing Systems** — Takamori et al.

Useful Links	
1	https://www.sw.siemens.com/en-US/digital-twin/?utm
2	https://new.abb.com/products/robotics?utm
3	https://www.ptc.com/en/technologies/digital-twin?utm

7MD325 V Fundamentals of System Engineering and Architecture 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in System Engineering
Class, Semester	TY BTech (all), V
Course Code	
Course Name	Fundamentals of System Engineering and Architecture
Desired Requisites:	Basic Engineering Knowledge, Engineering Graphics, Programming Fundamentals, Project-Based Learning Experience

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Introduce systems thinking and systems engineering principles used in the design and management of complex engineering systems.
2. Develop the ability to analyze stakeholder needs, system requirements, architecture, interfaces, and life-cycle considerations.
3. Apply systems engineering tools and model-based approaches for multidisciplinary problem solving.
4. Enable students to design, evaluate, and communicate system architectures for modern engineering applications.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain systems thinking concepts, system life cycle stages, and systems engineering processes used in multidisciplinary engineering projects.	Understand	II
CO2	Apply systems engineering methods and model-based tools to develop system architectures and design solutions.	Apply	III
CO3	Analyze stakeholder needs, requirements, interfaces, risks, and trade-offs in complex engineering systems.	Analyze	IV
CO4	Design and evaluate integrated engineering systems considering performance, sustainability, reliability, safety, and lifecycle requirements.	Create	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	-	1	-	1	-	-	-	1	-	-
CO2	-	3	2	2	-	-	1	-	-	2	-
CO3	1	-	-	-	3	1	1	-	2	-	1
CO4	2	2	3	3	2	2	2	1	3	3	2

Module	**Module Contents**	**Hours**

I	**Introduction to Systems Engineering** Evolution of Systems Engineering, Systems Thinking, Characteristics of Complex Systems, System of Systems (SoS), System Life Cycle, Stakeholders and Stakeholder Needs, Engineering Design versus Systems Engineering, Case Studies from Aerospace, Automotive, Smart Cities and Manufacturing Systems.	**5**
II	**Requirements Engineering and System Definition** Stakeholder Analysis, Voice of Customer (VOC), Requirements Engineering Process, Functional and Non-Functional Requirements, Requirement Hierarchy, Requirement Traceability Matrix (RTM), Use Cases, User Stories, Requirement Verification and Validation, Introduction to Standards (ISO/IEC/IEEE 15288).	**5**
III	**System Architecture and Functional Modelling** System Architecture Fundamentals, Functional Decomposition, Functional Flow Block Diagrams (FFBD), System Context Diagrams, Interface Definition, Product Architecture, Physical and Logical Architectures, Architecture Trade Studies, Design Structure Matrix (DSM), Digital Engineering Concepts.	5
IV	**Model-Based Systems Engineering (MBSE)** Introduction to MBSE, SysML Overview, Block Definition Diagrams, Internal Block Diagrams, Use Case Diagrams, Activity Diagrams, Digital Twin Concepts, Systems Modelling Tools, Lifecycle Digital Thread, Applications in Smart Manufacturing, Autonomous Systems and Industry 4.0.	5
V	**Systems Integration, Verification and Risk Management** System Integration Strategies, Interface Management, Verification and Validation (V&V), Technical Reviews, Reliability Fundamentals, Failure Modes and Effects Analysis (FMEA), Risk Assessment, Safety Engineering, Cyber-Physical Systems, Sustainability Considerations.	5
VI	**Emerging Applications of Systems Engineering** Systems Engineering for Autonomous Vehicles, Robotics Systems, Smart Grids, Space Systems, Healthcare Systems, Smart Infrastructure, AI-enabled Systems, Internet of Things (IoT), Digital Engineering, Sustainable and Resilient Systems, Future Trends in Systems Architecture.	5
		Total Hrs : 30

Interaction Activities (1 Hour per Week)

- Case Study Discussions
- Stakeholder Mapping Exercise
- Requirements Development Workshop
- System Architecture Design Challenge
- SysML Modelling Exercise
- FMEA and Risk Analysis Workshop
- Industry Case Analysis
- Mini Project Reviews

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1.	Quiz, Crossword etc. using online tools	Assessment of Systems Thinking, System Life Cycle, Stakeholder Needs and Requirements Engineering concepts	10	6 hrs	3
	2.	Assignments	Requirement Traceability Matrix (RTM), Functional Decomposition and Architecture Modelling Assignment	10	6 hrs	5
MSE	3.	Mini-Project/ Seminar	System Architecture Development and Presentation on a Selected Engineering System	15	8 hrs	7
	4.	Open Book Exam/ Critical problem method	Case-based analysis involving Requirements, Trade-off Studies and Systems Integration	15	8 hrs	9
ESE	5.	Certification course of 10-12hr duration on platform like coursera /Udemy/NPTEL	Report and Reflection on Industry Visit, Smart Manufacturing Facility, Robotics Lab or Engineering System Case Study	10	10 hrs	11
	6.	Mini-Project/ Seminar	MBSE/SysML Modelling, Architecture Evaluation and Technical Review	15	8 hrs	12
	7.	Prototype Making	Development of Conceptual/Digital Prototype, Digital Twin, Functional Model or System Demonstrator	15	8 hrs	14
	8.	Report on Lab/Industry Visit	Completion of approved course in Systems Engineering, MBSE, Digital Engineering, Reliability or Project Management	10	6 hrs	15
			Total	**100**	**60 hrs**	

Text Books

1	Dennis M. Buede and William D. Miller, Systems Engineering and Analysis, 6th Edition, Wiley, 2024.
2	Howard Eisner, Essentials of Project and Systems Engineering Management, Wiley, 2018.
3	INCOSE Systems Engineering Handbook, 5th Edition, Wiley, 2023.
4	Alan Dennis, Barbara Haley Wixom and David Tegarden, Systems Analysis and Design, Wiley, 2020.

References

1	Bruce Powel Douglass, Agile Systems Engineering, Morgan Kaufmann, 2015.
2	Sandy Friedenthal, Alan Moore and Rick Steiner, A Practical Guide to SysML, Morgan Kaufmann, 2023.
3	Mohammad Jamshidi, Systems of Systems Engineering: Principles and Applications, CRC Press.
	NASA Systems Engineering Handbook, NASA/SP-2016-6105 Rev 2.
Useful Links	
1.	INCOSE Learning Resources – https://www.incose.org
2.	NASA Systems Engineering Handbook – https://www.nasa.gov/seh
3.	Capella MBSE Open Source Tool – https://www.eclipse.org/capella
4.	SysML Open Source Learning – https://sysml.org
5.	MIT OpenCourseWare: Systems Engineering – https://ocw.mit.edu
6.	Coursera Systems Engineering Specialization – https://www.coursera.org
7.	NPTEL Systems Engineering Courses – https://nptel.ac.in
8.	Digital Engineering and MBSE Resources – https://www.omg.org/sysml

7MD327 V Ideation to Prototyping – Designing for Success 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Innovation and Entrepreneurship Development
Class, Semester	TY BTech (all), V
Course Code	7MD327
Course Name	Ideation to Prototyping – Designing for Success
Desired Requisites:	Fundamentals of Innovation and Entrepreneurship Course

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

After completing this course, students will be able to:

- Master advanced human-centered design principles and empathy-driven frameworks to translate complex consumer friction points into well-defined problem boundaries.
- Formulate practical engineering, digital, or service prototyping strategies by balancing product desirability, technical feasibility, and business model viability.
- Apply iterative agile methodologies and build minimum viable products (MVPs) using modern fabrication, no-code, or service modeling tools.
- Establish structured feedback mechanisms, usability heuristics, and testing parameters to gather data-driven validation metrics from real-world users.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	**Deconstruct** complex market problems and user friction points into actionable, human-centered design briefs using empathy maps and customer journey pathways.	Analyze	IV
CO2	**Appraise** various prototyping mediums (hardware, software, or service blueprints) to select the optimal technical fidelity for targeted user validation.	Evaluate	V
CO3	**Construct** functional Minimum Viable Products (MVPs) or interactive models using rapid manufacturing, digital UX, or service prototyping tools.	Create	VI
CO4	**Execute** structured usability testing and live experiments to iterate the design solution based on empirical user feedback data.	Apply	III

CO – PO Mapping

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

Module	Module Contents	Hours
I	**Module I: Advanced Ideation and Problem Refinement** Moving beyond basic brainstorming to advanced frameworks (e.g., TRIZ, Lateral Thinking, Disney Method). Deep dive into user empathy mapping, persona development, and constructing "How Might We" (HMW) statements. Transitioning from the Semester IV generic problem-solving to a highly targeted, customer-centric problem definition.	5
II	**Module II: Design Thinking & Human-Centered Design (HCD)** Principles of Human-Centered Design (HCD). Mapping the customer journey (Touchpoints, Pain points, Moments of Truth). Understanding ergonomics, usability, aesthetics, and emotional design. Balancing desirability (what people want) with feasibility (what is technically possible) and viability (what makes business sense).	5
III	**Module III: Architecture of a Prototype – Hardware, Software & Services** Anatomy of a prototype. Low-fidelity vs. High-fidelity prototyping strategy. • *For Physical Products:* Materials, 3D printing/rapid manufacturing concepts, form factors. • *For Digital/Software Products:* User Interface (UI) and User Experience (UX) basics, wireframing, mockups, and no-code/low-code tools. • *For Service Products:* Service blueprints, storyboarding, role-playing, and customer experience workflows.	5
IV	**Module IV: The MVP Framework and Agile Development** The philosophy of the Minimum Viable Product (MVP). Differentiating between a prototype, a smoke test, and an MVP. Defining the "Core Value Proposition" features vs. "Nice-to-Have" features (Feature Prioritization Matrix like MoSCoW method). Introduction to Agile development cycles, Scrum basics, and iterative sprint planning for rapid building.	5
V	**Simulation, and User Validation** Designing validation experiments. Alpha and Beta testing frameworks. Setting up usability testing metrics (Task completion rates, error rates, User Satisfaction scores). Collecting qualitative feedback through structured user interviews and observation. Introduction to digital/physical simulation tools to test structural or software integrity before physical deployment. Module V: Product Testing,	5
VI	**Module VI: Iteration Dynamics and Design for Scalability** Analyzing user test data to make data-driven design decisions. The Pivot vs. Persevere framework. Introduction to "Design for Excellence" (DFX) concepts: Design for Manufacturing (DFM), Design for Assembly (DFA), and cost optimization of the prototype. Documenting the technical design (Bill of Materials, Schematics, or Software Architecture charts) to hand off to Semester VI (Strategy) and Semester VII (Scaling).	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.	Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz / Online Tools	Online quiz on Human-Centered Design (HCD) principles and prototyping methodologies.	5	2
	2	Empathy Mapping / User Persona	Submission of user empathy maps and target customer personas for the chosen problem statement.	5	2
	3	Customer Journey Mapping	Visual mapping of the customer journey, identifying touchpoints and specific user pain points.	10	2
MSE	4	UI/UX Wireframing or Component Layout	Demonstration of low-fidelity digital wireframes (Figma) or preliminary physical component layouts.	10	4
	5	Feature Prioritization Matrix	Visual framework mapping (e.g., MoSCoW method) to isolate core MVP features from "nice-to-have" additions.	5	3
	6	Design Sprint Presentation	A rapid presentation highlighting early-stage design iterations and agile sprint progress.	5	2
	7	Low-Fidelity Prototype Pitch	Presentation of a physical/digital/service mockup (cardboard, paper, or interactive digital layout).	10	4
ESE	8	User Validation Strategy Contest	Presentation of the experiment design, metrics selection, and feedback collection plan.	10	4
	9	Test-Run Data & Analytics Challenge	Submission of the raw feedback and quantitative metrics gathered during initial user testing.	10	5
	10	High-Fidelity MVP Presentation	Integrated product development showcase demonstrating the functional prototype and its Validation Report.	20	8
	11	Scalability & Handoff Blueprint Seminar	Seminar/report outlining the Bill of Materials (BOM), DFX considerations, and structural handover for business strategy mapping.	10	2

Text Books

1	*Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, Tim Brown, Harper Business, Revised Edition.
2	*Product Design and Development*, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw-Hill Education, 6th Edition.
3	*Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days*, Jake Knapp, John Zeratsky, and Braden Kowitz, Simon & Schuster, 1st Edition.

References	
1	*The Design of Everyday Things*, Don Norman, Basic Books, Revised and Expanded Edition.
2	*UX for Lean Startups: Faster User Research with Less Waste*, Laura Klein, O'Reilly Media, 1st Edition.
3	*Testing Business Ideas: A Field Guide for Rapid Experimentation*, David J. Bland and Alexander Osterwalder, Wiley, 1st Edition.
Useful Links	
1	Interaction Design Foundation (IxDF) — Prototyping & UX Resources https://www.interaction-design.org (Practical learning on low-to-high fidelity prototyping workflows, UX/UI frameworks, usability testing, and wireframing best practices)
2	**MIT OpenCourseWare — Product Design and Development** https://ocw.mit.edu *(Academic open-course materials, case studies, and structured methodology examples covering engineering prototyping, DFM, and physical product architectures)*

7MD319 V Searches and Logic in AI 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2026-27 onwards

Course Information

Programme	MDM in AIML
Class, Semester	Third Year_Btech, Sem-V
Course Code	7MD319
Course Name	Searches and Logic in AI
Desired Requisites:	AI Basics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To understand the fundamental concepts of Artificial Intelligence, intelligent agents, and search techniques used for problem solving.
2. To analyze and apply game search algorithms, local search methods, and Constraint Satisfaction Problem (CSP) techniques in complex environments.
3. To develop knowledge of propositional logic and First-Order Logic (FOL) for knowledge representation and automated reasoning.
4. To explore knowledge representation techniques, inference mechanisms, and reasoning methods for designing intelligent systems.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Apply intelligent search techniques and optimization methods to solve problems in complex and partially observable environments.	Apply	III
CO2	Apply propositional logic to represent and solve AI reasoning problems.	Apply	III
CO3	Analyze game-playing strategies and Constraint Satisfaction Problem (CSP) techniques for decision making and problem solving.	Analyze	IV
CO4	Apply representation and reasoning techniques to design intelligent and knowledge-based systems.	Apply	III

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO 1**	**PO2**	**PO3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	2	1	2			1	1		1
CO2	3	3	2	2	2	2		2			1
CO3	3	2	2	2	2		2				1
CO4	3	3	2	2	1		2	2	3	3	2

Module	**Module Contents**	**Hours**
I	**Search in Complex Environments:** Introduction to Local Search and Optimization, Local Search in Continuous Spaces & Non Deterministic Actions, Search in Partially Observable Environments	5
II	**Game Theory and Search in Games:** Introduction to Game Theory, Optimal Decisions in Games, Alpha-Beta Pruning and Move Ordering, Partially Observable Games, Limitations of Game Search Algorithms	5

III	**Constraint Satisfaction Problems (CSPs):** Introduction to CSPs, Constraint Propagation & Inference in CSPs, Backtracking Search for CSPs, The Structure of Problems, Applications	5
IV	**Logical Agents and Propositional Logic:** Knowledge-Based Agents, Propositional Logic :Syntax, Semantics, Propositional Theorem Proving, Effective Propositional Model Checking: Complete backtracking algorithm	5
V	**First-Order Logic (FOL) and Inference:** Syntax and Semantics of First-Order Logic, Using First-Order Logic: Assertions and queries, Numbers, Sets, Lists, Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and First-Order Inference	5
VI	**Knowledge Representation and Reasoning:** Ontological Engineering, Categories and Objects : Physical composition, Events and Time Representation, Mental Objects and Modal Logic	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours*)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz, Crossword etc. using online tools	Continuous Assessment, Knowledge Check, application of basics and analytical skill	10	10hrs	Throughout course
	2	Assignments	Design a simple Knowledge Base using logic	10	10hrs	Throughout course
MSE	3	Open Book Exam	Suitable for evaluating comprehension ,analysis, synthesis, and evaluation rather than rote learning.	15	10hrs	Week 9
	4	Group Discussion	Content Relevance and Knowledge, Team Interaction and Collaboration	15	10Hrs	Week 10
ESE	5	Case Study Presentations/ Debating	Analyzing a complex real-world PA implementation and presenting findings/arguments).	30	10 hrs	Weeks 12–13
	6	Oral/Viva Exam	(Assessing conceptual clarity, project	20	10hrs	Week 14-15

			knowledge, and communication skills).			
				Total	**100**	**60 hrs**

Text Books	
1	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd/4th ed., Pearson Education, 2010/2021.
2	R. Brachman and H. Levesque, Knowledge Representation and Reasoning, 1st ed., Morgan Kaufmann, 2004
References	
1	Artificial Intelligence E. Rich, K. Knight, and S. B. Nair, *Artificial Intelligence*, 3rd ed. New Delhi, India: McGraw-Hill Education, 2009.
2	A Mathematical Introduction to Logic H. B. Enderton, *A Mathematical Introduction to Logic*, 2nd ed. San Diego, CA, USA: Academic Press, 2001.
3	Paradigms of Artificial Intelligence Programming P. Norvig, Paradigms of Artificial Intelligence Programming: Case Studies in Common Lisp. San Francisco, CA, USA: Morgan Kaufmann, 1992.
Useful Links	
1	https://nptel.ac.in/courses/106102220/
2	https://nptel.ac.in/courses/106105470/
3	https://nptel.ac.in/courses/106105077
4	https://nptel.ac.in/courses/112103280
5	https://nptel.ac.in/courses/106108227

7MD328 V Smart Infrastructure 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM - Smart Cities)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	7MD328
Course Name	Smart Infrastructure
Desired Requisites:	Understanding of urban planning concepts

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1 To understand the concept of smart city and associated challenges.
2 To identify latest technologies used in Infrastructural Planning.
3 To realize the foundational principles underlying IoT.
4 To implement various smart techniques used for smart city development.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Understand the concept of smart & sustainable city and associated challenges.	Understanding	II
CO2	Identify the requirements of Smart village concept and correlate with villages nearby.	Remember	I
CO3	Analyze modern smart infrastructure technologies and their feasibility for sustainable infrastructural planning.	Analysing	IV
CO4	Create and evaluate modern tools to derive meaningful insights in designing smart cities.	Creating	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3					3					1
CO2	1	3			1	3					
CO3	1	3			3	3					
CO4	1		3		3	3					

Module	Module Contents	Hours
I	**Introduction to Smart city** Defining Smart Cities & Classifying them (Greenfield, Retrofitted), Concept, History, Need, Benefits and importance of smart cities in India, Key Features, Components, Scope of a Smart city, Challenges and future trends of Smart City.	5
II	**Smart Village Ecosystem** Smart irrigation, weather monitoring and forecasting, precision agriculture, soil health monitoring, Smart Green House, Hydroponics farming, animal tracking, remotely monitoring the health of an animal, Smart Aquaculture	5

III	**Infrastructure Management System** Infrastructure Management in India, Challenges, Objectives, Various types of Infrastructure Services, Applications for Existing Smart City. Implementing smart infrastructure: Some key challenges and policy instruments, Key drivers for smart cities infrastructure.	4
IV	**Smart Technologies for Safety and Disaster Management** Introduction to Disaster Management, Phases of disaster management, Role of technology in disaster management, Drones for Disaster Management, Smart home, Street lighting, Safety and surveillance, Real-world examples of smart technologies in disaster management.	6
V	**Smart Technologies for environment management** Technologies for - Water Management, Waste Management, Air Quality Management, Energy Management.	4
VI	**Intelligent Transport Systems** Smart mobility and transportation, Intelligent transport system and traffic management, Components of ITS, Challenges and opportunities in ITS, Multimodal transportation, Navigation system- GPS, Cellular Technologies for Vehicular Communication, Connected and Autonomous Vehicles Smart parking, Smart Fleet Management System.	6
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Assignments	Module wise assignment completion	10	2	3-4
	2	Quiz using online tools	Quick assessment of conceptual understanding.	10	3	11-12
MSE	3	Digital Poster Making (or Sketching) and Presentation	Prepare and present digital sketches or posters of smart infrastructure planning and management for village ecosystem as well as urban infrastructure.	15	10	7-8
	4	Design Challenge/ Mini project	Preparation of a basic Plan (residential/public) with proper orientation and zoning. Evaluate practical application of planning, prevention and response system for disaster management and response.	15	10	7-8
ESE	5	Seminar / Case Study Presentation	Presentation on a short case study on smart Technologies for resource management, safety and transportation systems.	25	25	12-13
	6	Report on Lab/Industry Visit –	Report based on site visit or case study of any existing or proposed smart infrastructure.	25	10	13-14
			Total	100	60 hrs	

Text Books

1	Jo Beall, “A city for all: valuing differences and working with diversity”; Zed books limited, London (ISBN: 1- 85649-477-2), 1997.
2	Rhind and H. Mounsey, Understanding GIS. Taylor and Francis. London, 1989.
3	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
4	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, and Wiley, 2012

5	Amit Kumar Tyagi, Niladuri Srinath, “Intelligent Transportation Systems: Theory and Practice”, Springer Nature Publication, 2022.
References	
1	Peter O'Connell, GIS for Urban and Regional Planning".
2	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Pearson Education (Cisco Press Indian Reprint).
3	Zaigham Mahmood, Internet of Things for Smart Cities: Technologies, Big Data and Security.
4	75+ case studies of Innovative Projects of Smart Cities Mission, National Institute of Urban Affairs, 2023.
5	Technical Report on IoT/ICT enablement in Smart Village and Agriculture, TEC, Department of Telecommunications, 2021 (https://www.tec.gov.in/M2M-IoT-technical-reports).
Useful Links	
1	https://tomorrow.city/a/technology-for-smart-cities-the-pillars-of-urban-planning-of-the-future
2	https://www1.nyc.gov/assets/forward/documents/NYC-Smart-Equitable-City-Final.pdf
3	https://smartcity.go.kr/wp-content/uploads/2019/08/Smart-city-broschureENGLISH.pdf
4	http://indiansmartcities.in/downloads/CONCEPT_NOTE_3.12.2014_REVISED_AND_LATEST.pdf

7MD3293	**V**	**Drives and Control for Electric Vehicles**	**2**	**0**	**1**	**0**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM: Electric Vehicle Technology
Class, Semester	T. Y. B. Tech Sem V
Course Code	7MD329
Course Name	Drives and Control for Electric Vehicles
Desired Requisites:	Nil

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1.	To introduce students to electric vehicle powertrain architecture and drive systems.
2.	To familiarize students with electric motors and power electronic converters used in EVs.
3.	To develop an understanding of EV drive control strategies and energy management techniques.
4.	To enable students to analyze battery management systems and their role in EV performance.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	**Explain** the architecture and operation of EV powertrain systems.	II	Understand
CO2	**Select** suitable motors, converters, and batteries for specific EV applications.	III	Apply
CO3	**Analyze** EV drive control strategies and power electronic converter operations.	IV	Analyse
CO4	**Analyze** battery management systems and energy management techniques in EVs.	IV	Analyse

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2					2				
CO2	3	3	2		2		2				
CO3	2	3		2	2						
CO4	2	3	2	2	2		3				

Module	**Module Contents**	**Hours**
I	**Introduction to Electric Vehicle Powertrains** Evolution of transportation and electrification, Types of EVs: BEV, HEV, PHEV, FCEV, EV powertrain architecture, Components of EVs, Vehicle dynamics and tractive effort requirements, EV performance parameters, Comparison with ICE vehicles	4
II	**Power Electronics for EV Applications** Role of power electronics in EVs, Power semiconductor devices: Diode, MOSFET, IGBT, SiC and GaN devices, DC-DC converters in EVs, Traction inverters, On-board chargers, Fast charging technologies, Vehicle-to-Grid (V2G) concept	5

III	**Electric Motors for EV Applications** Requirements of traction motors, Performance characteristics of EV motors, Introduction to: Induction Motor (IM), Permanent Magnet Synchronous Motor (PMSM), Brushless DC Motor (BLDC), Switched Reluctance Motor (SRM), Torque-speed characteristics, Efficiency and power density considerations, Comparative evaluation and motor selection	6
IV	**EV Drive Systems and Motor Control** Concept of electric drives, Drive train configurations, Motor control requirements, V/f control of induction motor, Field-oriented control (conceptual), Direct Torque Control (conceptual), Regenerative braking, Torque and speed control in EVs	6
V	**Hybrid and Electric Vehicle Control Strategies** Series hybrid architecture, Parallel hybrid architecture, Series-parallel hybrid architecture, Energy management strategies, Drive mode selection, Regenerative energy recovery, Case studies of commercial EVs	5
VI	**Batteries and Battery Management Systems** EV battery technologies, Lithium-ion battery chemistry, Battery packs and thermal management, Battery parameters and performance, State of Charge (SOC), State of Health (SOH), Battery Management System architecture, Cell balancing, Battery safety and protection, Emerging battery technologies	4
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Quiz / MCQ Test**	Quiz covering EV fundamentals, EV architectures, powertrain components, power electronics, and battery technologies (Modules I & II)	**10**	**5**	**3**
	2	**EV Component Selection Assignment**	Selection of suitable motor, battery pack, inverter, and charger for a given EV application (e-bike, passenger EV, commercial EV, etc.) with justification	**10**	**5**	**10**
MSE	**3**	**Numerical & Case-Based Problem Solving**	Problems on vehicle dynamics, tractive effort calculation, battery sizing, SOC estimation, motor selection, and regenerative braking analysis	**15**	**5**	**6**
	4	**Simulation / Software-Based Activity**	MATLAB/Simulink, Scilab, or spreadsheet-based analysis of EV powertrain, motor characteristics, battery SOC estimation, or regenerative braking	**15**	**10**	**8**
ESE	**5**	**EV Case Study Presentation**	Detailed analysis of a commercial EV (e.g., Tata Nexon EV, Mahindra BE 6, MG Windsor, Hyundai Kona, Tesla Model 3) focusing	**25**	**20**	**11**

			on powertrain, motor, inverter, battery pack, BMS, and control strategy			
	6	**Technical Poster Presentation**	Poster presentation on emerging EV technologies such as solid-state batteries, V2G, fast charging, AI-based energy management, SiC/GaN converters, autonomous EVs, etc.	**25**	**15**	**13**
			Total	**100**	**60 hrs**	

Text Books	
1	James Larminie and John Lowry, "Electric Vehicle Technology Explained", Wiley Publications, 2nd Edition, 2012.
2	Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2011.
3	John G. Hayes and G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", Wiley Publications, 2018.
4	Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2018.
5	M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 2017.
References	
1	Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 2014.
2	Chris Mi, M. Abul Masrur, and David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley Publications, 2017.
3	Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2002.
4	Tom Denton, "Electric and Hybrid Vehicles", Routledge, 2020.
5	Gregory L. Plett, "Battery Management Systems", Artech House, 2015.
6	Gregory L. Plett, "Battery Management Systems", Artech House, 2015.
7	Wakihara Masataka and Osamu Yamamoto, "Lithium-Ion Batteries: Fundamentals and Performance", Wiley Publications, 2008.
8	Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
Useful Links	
1	https://nptel.ac.in/courses/108106170
2	https://archive.nptel.ac.in/courses/108/103/108103009/
3	https://onlinecourses.nptel.ac.in/noc22_ee53/preview

7MD3303	V	Risk Management and Compliance	2	0	1	0

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM – FinTech)
Class, Semester	Third Year B. Tech. SEM-V
Course Code	7MD330
Course Name	Risk Management and Compliance
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To provide an understanding of different types of financial and operational risks.
2. To explore risk management techniques and their application in financial markets and institutions.
3. To introduce students to compliance frameworks and regulatory environments in India.
4. To enhance awareness of enterprise risk management (ERM) and global standards such as Basel norms.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Identify various types of risk faced by businesses and financial institutions.	Understand	2
CO2	Analyze techniques and tools for risk measurement and mitigation.	Analyse	3
CO3	Evaluate compliance requirements and legal frameworks in the Indian context.	Applying	4
CO4	Apply risk management strategies in practical financial scenarios.	Evaluate	5

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	3	-	-	2	-	-	-	-	-	2
CO2	1	1	3	-	3	-	-	-	-	1	2
CO3	-	1	1	3	3	-	-	-	-	1	1
CO4	-	-	-	-	-	-	-	-	3	3	1

Module	Module Contents	Hours
I	Business Structures and Legal Compliance Sole proprietorship, partnership, limited liability partnership (LLP), private limited company, public limited company. Key legal and compliance aspects of each form.	5
II	Introduction to Risk Management Definition of risk, types of risk (credit, market, operational, liquidity, legal, reputational). Importance of risk management in finance. Risk vs Uncertainty.	4
III	Risk Identification and Assessment Risk measurement tools – Value at Risk (VaR), sensitivity analysis, stress testing. Risk quantification – Exposure, probability, and impact.	6

IV	Risk Mitigation and Control Hedging, diversification, insurance, derivatives for risk management (brief intro). Internal controls, audit, and monitoring. Risk appetite and tolerance.	6
V	Compliance and Regulatory Environment in India Role of SEBI, RBI, IRDAI. Overview of key regulations – FEMA, PMLA, Companies Act compliance. AML (Anti-Money Laundering) and KYC norms.	6
VI	Industry-Specific Risk and Compliance Risk and compliance in Banking, Insurance, Manufacturing, and IT. Case studies of regulatory lapses and corporate failures. Role of internal audit and compliance officers. Practical Component: Analyze a real-life regulatory breach in a sector-specific context and suggest corrective strategies. (Global Financial Crisis – 2008)	6
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment + Practice Problems	Assignment on **Module 1 & Module 2**:	**10**	**6 hours**	Week 3
	2	Mini-Task	Short case on **Module 3**.	**10**	**6 hours**	Week 6
MSE	**3**	Mid-Semester Examination(MCQ or descriptive)	Written exam covering **Module 1, 2, and 3** with problem-solving	**30**	**12 hours**	Week 8
	4	**Case-Based Written Examination (Application Focused)**	Exam on **Modules 4–6** using scenarios.	20	10	12
ESE	**5**	ESE Exam (MCQ or descriptive)	**Optional component inside ESE**, includes scenario-based questions on **Modules 4, 5 & 6**	30	**10 hours**	Week 16
			Total	**100**	**60 hrs**	

Text Books

1	John C. Hull, Risk Management and Financial Institutions, Wiley publications
2	George Rejda, Principles of Risk Management and Insurance: A Managerial Perspective, Pearson publications

References

1	Abhishek Tripathi, Compliance Management in Financial Industries (Taxmann)
2	James Lam, Enterprise Risk Management: From Incentives to Controls

Useful Links

1	NISM – National Institute of Securities Markets (Study Material & Certifications) https://nism.ac.in/online-examinations/nflq/
2	**RBI – Reserve Bank of India (Financial System & Regulations)** https://www.rbi.org.in
3	**Oliveboard – Financial Markets & Instruments (Articles & Guides)** https://www.oliveboard.in/blog/financial-markets/

7MD331 V Robot Kinematics and Dynamics 2 0 1 0 3

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2025-26					
Course Information					
Programme	B. Tech. (MDM - Robotics & Automation)				
Class, Semester	Third Year - B. Tech., Sem. V				
Course Code	7MD331				
Course Name	Robot Kinematics and Dynamics				
Desired Requisites:	Fundamentals of robotics, mathematics				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
	-	**Credits: 3**			

Course Objectives	
1	Understand industrial robot structures and their kinematic modelling.
2	Apply mathematical tools for robot position, orientation, velocity and motion planning.
3	Analyse robot mechanism behaviour using forward/inverse kinematics, Jacobians, and dynamics.
4	Evaluate robot motion trajectories, control fundamentals, and workspace characteristics.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand relationship between joint space and Cartesian space	II	Understanding
CO2	Apply mathematics for manipulator positioning and motion planning	III	Applying
CO3	Analyse robot mechanisms using kinematics and dynamics principles	IV	Analysing
CO4	Evaluate robot trajectories and motion behaviour in controlled environments	V	Evaluating

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

Module	**Module Contents**	**Hours**
I	**Module I – Mathematical Preliminaries and Forward Kinematics** Review of coordinate frames; Rotation representation, Rotation matrices, properties, Axis-angle, Rodrigues formula, Homogeneous transformation matrices, Representation of positions & orientations, Transformation between coordinate frames, Intro to velocity: Linear and angular velocity, Manipulator structure: links, joints, joint variables, Kinematic chains and serial manipulators Denavit–Hartenberg (D–H) parameters, frame assignment rules, Forward kinematics of common robots, Workspace characteristics and reachability	7
II	**Module II Forward Kinematics** Denavit–Hartenberg (D–H) parameters, frame assignment rules, Forward kinematics of common robots, Workspace characteristics and reachability	5
III	**Module III - Inverse Kinematics** Manipulator geometry, constraints, Geometric and algebraic IK methods, Typical robot structures (SCARA, 3R planar, 6-DOF manipulator), Workspaces	5

	and kinematic redundancy Analytical IK (for common industrial robots), Redundancy basics, Multiple solutions & workspace limits, basics of Numerical methods Newton–Raphson concept	
IV	**Module-IV Velocity Kinematics & Jacobians** Linear and angular velocities of links, Jacobian matrix, Velocity propagation (link-to-link), Mapping joint rates to end-effector velocities, Singularities: interpretation and examples, Basic manipulability concepts, Relationship between Jacobian & differential motion, Differentiation of transformation matrices.	5
V	**Module V – Introduction to Dynamics** Kinetic & potential energy of manipulators generalized coordinates, DOF, Lagrange-Euler formulation, Dynamic equations of simple manipulators, Inertia matrix, Coriolis & centrifugal terms (conceptual), gravity terms, Newton–Euler formulation (overview), Joint torques for simple manipulators, Actuator effects (friction, gearing basics).	4
VI	**Module VI – Trajectory Planning & Control Basics** Joint-space and Cartesian-space trajectories, Linear, cubic, and quintic polynomial trajectories, Introduction to robot motion control First-order and second-order error dynamics, Proportional (P) and PD control fundamentals, Basic stability concepts (qualitative). Introduction to Modern Robotics & wheeled mobile robots	4

Course Assessment Plan (*for total 60 learning hours*)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Solved Problem Presentations	Students will solve problems of Transformation/ Forward / Inverse Kinematics analytically/ using Python/ MATLAB/ RoboAnalyzer and Present	10	5 I+10 SL = 15	Week 4 to 7
	2	Solved Problem Presentations	Students will solve problems of Forward / Inverse Dynamics/ Joint Trajectory analytically/ using Python/ MATLAB/ RoboAnalyzer and Present	10	5 I+10 SL = 15	Week 12 to 15
MSE	**3**	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module I-III	15	15 SL	Week 8
	4	Quiz, Assignment	Objective/short-answer test/ Problem solving/Tutorial covering Module IV-VI	15	15 SL	Week 15
ESE	5	Exam Online (Preferred) / Offline	40% weightage on modules I to III and 60% weightage on modules IV to VI.	50	15 SL	Week 16
			Total	**100**	**60 hrs**	

Text Books

1	D.Nagrath and Mittal, “Robotics and Control”, Tata McGraw-Hill, 2003
2	John Craig, “Introduction to Robotics: Mechanics and Control”, Pearson Prentice Hall Pearson

	Education
3	Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008
4	Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2019
References	
1	Lynch, K. M., & Park, F. C. (2017). Modern Robotics: Mechanics, Planning, and Control. Cambridge University Press
2	Harry Asada and Slottine "Robot Analysis and Control", Wiley Publications, 2014
3	S K Saha, "Introduction to Robotics", 2nd edition, TMH, 2013
4	S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., 2020
Useful Links	
1	https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/
2	https://www.ni.com/en-us/innovations/instrumentation.html
3	https://www.coursera.org/learn/modernrobotics-course2
4	https://www.youtube.com/watch?v=Tf_DsOcCgio

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Self-Learning Component – 50 Hours
Students are expected to spend time on:

- Solving kinematics and dynamics exercises
- Studying the fundamental concepts from textbooks and reference books
- Studying Mini-case studies on industrial robots
- Reading simplified notes on dynamics, trajectory planning etc.
- Watching supplementary video lectures (e.g., NPTEL – Robotics by Prof. Dinesh Manocha/Prof. Dilip Pratihar, Coursera)

29. Course Content For Semester VI

7MD359 Machine Learning using Python 2 0 0 2 3

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2025 - 26 (Revised)					
Course Information					
Programme	B. Tech. MDM (Artificial Intelligence and Machine Learning)				
Class, Semester	Third Year | Semester VI				
Course Code	7MD359				
Course Name	Machine Learning using Python				
Desired Requisites:	Intermediate Python Programming, Foundational Mathematics				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. To equip students with the mathematical and statistical foundations for ML data preparation.
2. To validate Supervised Learning models for engineering prediction problems.
3. To develop methods for interpreting Unsupervised Learning results.
4. To address ethical issues in deploying ML models for engineering applications.

Course Outcomes (CO

CO	Description	Blooms Taxonomy	
		Descriptor	**Level**
CO1	Understand concepts of foundational mathematics and Mahine learning basics.	**Understand**	II
CO2	Apply modelling algorithms in both supervised as well as unsupervised set up for problems such as exploratory data analysis, predictions for classification and regression, and pattern mining in unsupervised set up such as clustering and PCA	**Apply**	IV
CO3	Analyse engineering aspects of model using performance metrics, generalization, cost of training and prediction, need for regularisation	**Analyse**	IV
CO4	Evaluate ML model suitability and assess ethical implications for deployment in specific engineering applications.	**Evaluating**	V

CO and PO Mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	1		1	2						1
CO2	2	2	1	2	2						1
CO3	2	2	1	2	2						1
CO4	1	1	2		1	2	2		1		2

Module	Module Contents	Hours
I	**Mathematics for ML** Linear Algebra basics, Vectors, Matrices, Visualization of Data, Basics of Applied Statistics.	05
II	**Introduction to Machine Learning Fundamentals** Types of Machine Learning, Core Concepts, Exploratory Data Analysis, Normalization, Outlier Detection in Univariate and Multivariate Data.	05
III	**Regression** Simple Linear, Multiple Linear Regression, Regression Model Evaluation. Regularisation and Generalization.	05
IV	**Classification Techniques** Classification Fundamentals and Logistic Regression, Classification Evaluation Metrics, K-Nearest Neighbours (K-NN), Decision Trees and Ensemble Methods.	05
V	**Unsupervised Learning** Introduction to Unsupervised Learning, K-Means Clustering, Hierarchical Clustering, Principal Component Analysis (PCA).	05
VI	**Specialized ML Applications in Engineering** ML in Mechanical Engineering, ML in Electrical/Electronics Engineering, ML in Civil Engineering, Model Deployment and Ethics.	05
		Total Hrs : 30

List of Laboratory Experiments

1. Python Fundamentals and EDA
2. Normalization
3. Outlier Detection
4. Multiple Linear Regression
5. Polynomial Regression
6. Logistic Regression
7. Decision Tree for Rule Extraction
8. Random Forest
9. Clustering
10. Domain specific Case Study

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	4	**Quiz, Crossword etc. (Online Tools)**	Objective, concept-based assessment on Python fundamentals, EDA, Normalization, and Outlier detection.	**10**	5	3
	16	**Testing and Debugging Activity**	Hands-on lab session where students debug pre-written code for Supervised Learning models (Regression/ Classification) and resolve data pre-processing errors.	**10**	10	**Throughout Semester**
MSE	5/32	**Seminar / Case Study Presentation**	Individual or small group presentation (Seminar) focused on **Analysing** and comparing the performance, regularization, and validation techniques of Supervised Learning models.	**30**	15	8
ESE	31 & 33	**Mini-Project & Oral/Viva Exam**	Comprehensive project (Mini-Project) integrating Unsupervised Learning, domain-specific application, and a final report assessing ethical deployment issues. Assessed via demonstration, report, and **Viva Exam** (30 marks Project + 20 marks Viva)	**50**	30	14
Total				**100**	**60 hrs**	

Text Books	
1	Vander Plas, Jake, ***Python Data Science Handbook: Essential Tools for Working with Data***, 1st ed., O'Reilly Media, 2016.
2	Hastie, Trevor, Tibshirani Robert, and Friedman Jerome, ***The Elements of Statistical Learning: Data Mining, Inference, and Prediction***, 2nd ed., Springer, 2009.
3	Shalev-Shwartz, Shai, and Ben-David, Shai, ***Understanding Machine Learning: From Theory to Algorithms***, Cambridge University Press, 2014.
References	
1	Hefferon, Jim., ***Linear Algebra***, St Michael's College, 2020.
2	Géron, Aurélien, ***Hands-On Machine Learning with Scikit-Learn, Keras, & TensorFlow***, 3rd ed., O'Reilly Media, 2022.

3	Deisenroth, Marc Peter, Faisal, A. Aldo, and Ong, Cheng Soon, ***Mathematics for Machine Learning***, 1st ed. (GitHub Edition), Cambridge University Press, 2020.
Useful Links	
1	https://nptel.ac.in/courses/106106139
2	https://nptel.ac.in/courses/111107137
3	https://onlinecourses.nptel.ac.in/noc25_cs49/preview
4	https://onlinecourses.nptel.ac.in/noc25_cs149/preview

7MD368 Data science and Analytics for Smart Cities 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Smart Cities
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	7MD368
Course Name	Data Science and Analytics for Smart Cities
Desired Requisites:	Basics mathematics, statistics and Python programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical		**Credits: 3**			

Course Objectives

1. To introduce concepts, functions and services of IoT systems, data handling and cloud computing.
2.To inculcate the concepts of data science, analytics and know-how of the various data processing tools.
3.To acquire the knowledge of data analytics and analysis along with the challenges involved in the implementation.
4. To explore visualization techniques for data analytics.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Understand the fundamentals of IoT system and its relevance in real world applications	Understanding	L2
CO2	Understand various cloud platforms and its data handling techniques in these platforms	Understanding	L3
CO3	Apply appropriate data analytics tools to manage, present, and interpret complex data, enabling generation of meaningful insights.	Analysing	L4
CO4	Integrate and apply data analytics concepts to develop innovative solutions for complex problems related to Smart Cities.	Creating	L5

CO – PO mapping

	Programme Outcomes (PO)											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1											
CO2	1	2		2								
CO3	2	3	3	3	2		2	1	1	1		1
CO4	2	3	3	3	2		2	1	1	2		1

Module	Module Contents	Hours
I	**Fundamentals of IoT, IoT Protocols and cloud platforms:** Introduction to IoT Layers and Architecture, Functions of IoT Devices, Sensors, Actuators and interfaces used in IoT system. IoT communication technologies, IoT protocols standards, Introduction to IoT cloud –Edge,Fog and Cloud Computing, Introduction to IoT cloud and its storage models , IoT platforms	5

II	**Essentials of Data Science and Analytics:** Fundamentals of data science and data security, Understanding the various levels of data, dealing with categorical variable, Introduction to big data and analytics Tools and Various types of Data's, Edge Streaming Analytics, Diff kinds of Data Analytics – Descriptive, Diagnostic, Predictive and Prescriptive.	5
III	**Data Visualization Tools and Techniques** Introduction to Visualization Tools, Basic and Advanced Visualization Tools, Creating Maps and Visualizing Geospatial Data, Control Flow (Conditionals Loops), Functions and Modules, Python NUMPY, PANDAS, Data visualization using R/Tableau, Python-matplotlib/ seaborn libraries for visualization.	5
IV	**Machine Learning (ML) Models** ML Fundamentals, Supervised (Linear, Logistic Regression) and Unsupervised Learning, Classification Algorithms (Decision Trees, KNN, Naive Bayes, SVM), Ensemble Methods (Random Forest, Gradient Boosting), Clustering Algorithms (K-means, DBSCAN), Model Evaluation Metrics – Recall, Precision, accuracy etc. Cross-Validation, Hyper parameter Tuning, error, ethical surveillance.	6
V	**Citizen-Centric Urban Analytics** Urban Analytics and Applications, Implications of data collection and analytics on Buildings, Places, and Transport, Utilities, Services and Governance, Proximity and Diversity	5
VI	**Case studies of Data Science Applications for Smart Cities** A Case Study of NEOM City, Saudi Arabia, Indian Smart City – Indore, Nagpur, Allahabad and Dehradun. Data analytics for the various use cases in the Smart City	4
		Total Hrs: 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Quiz using Online Tools	Quick assessment of conceptual understanding of IoT system basics.	10	2	
	2	Design of Experiment	Simple experiments for understanding IoT platforms.	10	3	
MSE	**3**	Online Coding Challenge (Hacker Rank)	Assignments on data analytics using Python/R	15	10	
	4	Certification small course of 10-12hr duration on platform like coursera /Udemy/NPTEL	Based on ML , Python, R and cloud analytics	25	25	
ESE	**5**	Case Study Presentation	Presentation on a short project/prototype idea related to smart cities	15	10	
	6	Prototype Making	Prototype implementation and demonstration with Report submission	25	15	
Total				**100**	**60 hrs**	

Text Books

1	Joel Grus "Data Science From Scratch: First Principles with Python", Second Edition (Greyscale Indian Edition) Paperback – 5 May 2019

2	McKinney, W., Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media, 2017.
3	R. Nageswara Rao, ―Core Python Programming, Dreamtech Press, 2nd Edition, 2017
4	"Internet of Things – A hands-on approach", Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
References	
1	Jasbir Singh Dhaliwal, Architectural Patterns and Techniques for Developing IoT Solutions, Packt Publishing Ltd, 2023.
2	Amir Alavi, William G. Buttlar, Data Analytics for Smart Cities, CRC press, 2019
3	Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham Mahmood
4	"Confluence of AI and IoT " Marriage Made in Heaven Paperback – by Vinay Solanki, Notion Press, 1 st edition, Dec 2023.
Useful Links	
1	https://www.udemy.com/course/python-for-data-analysis visualization/?couponCode=LEARNNOWPLANS
2	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
3	https://onlinecourses.nptel.ac.in/noc22_cs53/preview

7MD369 Embedded Systems for Automotive Applications 2 0 0 2 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Electric Vehicle
Class, Semester	Third Year B. Tech., Sem VII
Course Code	7MD369
Course Name	Embedded Systems for Automotive Application
Desired Requisites:	Introduction to Electric Vehicles, Drive Systems in Electric Vehicles

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	20	50	100
Practical	2 Hrs/week	**Credits: 3**			

Course Objectives

1. To provide students with a comprehensive understanding of embedded system applications in automotive engineering, emphasizing the design, development, and integration of embedded solutions for vehicle control, safety, and infotainment.
2. To provide the fundamental principles, standards, and protocols governing communication within EV systems

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Discuss the practical skills in designing, programming, and testing embedded systems for vehicle control.	II	Understanding
CO2	Describe various sensors and transducers used in electric vehicles.	II	Understanding
CO3	Explore the standards and protocols for EV communication.	III	Applying
CO4	Analyse case studies and real-world implementations of EV communication protocols.	IV	Analysing

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3										
CO2	3	3			2						1
CO3	3										
CO4	3	3	2		2	3		2	2		

Module	**Module Contents**	**Hours**
I	**Introduction to Embedded Systems** Overview of embedded systems and their role in automotive engineering, Architecture of microcontrollers used in automotive applications, architecture, Memory Organization, Internal Peripheral Modules: Digital Input Outputs, ADC, Timer/Counters, Interrupts, UART, PWM Concepts, External Interfaces: LEDs, Switches, , Relay and Motor Driver, DSP Controllers used in EV	5

II	**Advanced sensors technologies and their applications in EV** Opto-electronic sensors, Fiber optic sensor, Magnetic sensors, Digital transducers, Ultrasonic sensors, Micro sensors, Bio sensors, Smart sensor systems and applications, General architecture of a smart sensor – Self calibration, Wireless sensors, Vibration, position measurement in machine tools	5
III	**Fundamentals of CAN (Controller Area Network) Protocol** Overview of electric vehicle architecture, Importance of communication protocols in EVs, Evolution of EV communication standards, Controller Area Network (CAN), CAN protocol layers and message structure, Diagnostics and error handling in CAN	5
IV	**EV Charging Communication Protocols** Introduction to EV charging infrastructure, OCPP (Open Charge Point Protocol), ISO 15118 (Plug and Charge), Vehicle-to-Grid (V2G) Communication: Concept and significance of V2G communication, Standards and protocols for V2G communication, Applications and challenges of V2G integration.	5
V	**Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) Communication** Overview of V2V communication in electric vehicles, IEEE 802.11p (Wireless Access for Vehicular, Environments - WAVE), Safety and cooperative driving applications of V2V, Role of V2I communication in smart mobility, DSRC (Dedicated Short Range Communication), Integration of V2I with traffic management systems.	5
VI	**Emerging Technologies and Future Trends in EV** Analysis of real-world implementations of EV communication protocols, Case studies of successful EV communication deployments, Hands on exercises and demonstrations, Threats and vulnerabilities in EV communication, Security protocols and measures for protecting EV systems, Privacy concerns and data protection regulations	5
		Total Hrs : 30

List of Laboratory Experiments/ Practicals (if applicable)

1. Simulation of Automotive Sensor Signal Conditioning
2. PWM Generation and Motor Speed Control (DC/BLDC Motor)
3. Modeling and Simulation of CAN Bus Communication
4. Cruise Control System Simulation using PID Control
5. Electronic Throttle Control (ETC) System Simulation
6. Battery Management System (BMS) Simulation for Electric Vehicles
7. Modeling Automotive Lighting Control System
8. EV/Hybrid Vehicle Powertrain Simulation

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Design Thinking Exercises	Ideation challenges	20	10	3
MSE	2	Short Quizzes / Unit Tests	Concept-based MCQs	30	5	9
ESE	3	Mini-Project	Small application-oriented projects which includes design, coding, testing, and report preparation	30	15	13
	4	Case Study Presentation	Industry-oriented problem statements	10	10	11
	5	Oral/Viva Exam	Concept understanding	10	10	13
			Total	100	60 hrs	

Text Books	
1	Sumedha Rajakaruna and Nick Jenkins, “Electric Vehicle Integration into Modern Power Networks”, Springer (2013).
2	Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
3	
4	
References	
1	Kathiresh, M., & Neelaveni, R., Automotive Embedded Systems. Springer International Publishing (2021).
2	Zurawski, R., Embedded Systems Handbook: Embedded systems design and verification CRC press (2018).
3	Neaimeh, M., Andersen, P.B. Mind the gap- open communication protocols for vehicle grid integration. Energy Inform 3, 1 (2020)
Useful Links	
1	P. K. Tripathi, Handbook on Electric Vehicles Manufacturing, 1 January 2022.
2	https://www.nxp.com/
3	

7MD371 Computer Vision in Robotics 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Robotics and Automation
Class, Semester	TY B. Tech., Sem VI
Course Code	7MD371
Course Name	Computer Vision and Robotics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr/ Week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To Assist the students to understand computer vision and image processing to enhance detection and object recognition for robots
2. To introduce the fundamentals of computer vision and its role in robotics.
3. To understand basic image processing and feature extraction concepts.
4. To gain conceptual knowledge of 3D vision, localization, and SLAM.
5. To understand the application of machine learning and deep learning in robotic vision.
6. To develop awareness of vision-based robot control, integration, and ethical issues.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Discuss basic knowledge of computer vision, image processing and camera systems used in mobile robots.	II	Understanding
CO2	Analyse different perspectives of geometry for an image, object model and matching.	IV	Analysing
CO3	Describe working of different sensors used in robots	II	Understanding
CO4	Analyse different types of computer visions for robotics applications	IV	Analysing

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3										
CO2	3	3			2						1
CO3	3										
CO4	3	3	2		2	3					

Module	**Module Contents**	**Hours**

I	**Foundations of Computer Vision & Robotics** Evolution of robotics and role of perception, Vision vs. other sensing modalities (LiDAR, RADAR, IMU), Computer vision pipeline for robotic systems: perception → understanding → action, Real-world application domains: autonomous vehicles, drones, industrial robots, medical robots, service robots, agriculture robots	5
II	**Image Processing and Feature Extraction** Image filtering & enhancement: Smoothing, sharpening, edge detection, 2D convolution, kernels, Color models (RGB, HSV, YCbCr), Feature detection- Harris Corner, FAST, ORB, SIFT/SURF concepts, Feature description & matching, Morphological operations for robotics tasks, Hands-on with OpenCV fundamentals	5
III	**3D Vision, Geometry, and Robot Perception** Camera calibration & distortion models, Stereo vision- Epipolar geometry, Depth estimation, Structure-from-Motion (SfM) basics, Visual Odometry (VO) fundamentals, SLAM overview (Mono, Stereo, RGB-D), Point cloud processing (PCL basics), Robot localization using vision, Applications: mapping, obstacle detection, navigation	**5**
IV	**Machine Learning & Deep Learning for Vision in Robotics** Traditional ML for vision: SVM, kNN, PCA, CNNs for robotic perception- Image classification, Feature extraction with deep models, Object Detection (YOLO, SSD, Faster R-CNN), Semantic & Instance Segmentation (U-Net, Mask R-CNN), Depth estimation using deep networks, Vision transformers (ViT) for robotics, Real-time inference challenges on robotics hardware (GPU/TPU/Edge devices)	**5**
V	**Vision-Based Robot Control & Applications** Visual Servoing (IBVS, PBVS), Object tracking for robotic manipulation- Kalman filter, optical flow (Lucas–Kanade), Deep SORT, Grasp detection & pose estimation, Human–robot interaction using vision, Vision-based SLAM integrations in ROS, Simultaneous perception & planning, Applications: pick-and-place, warehouse robots, drone navigation, automated inspection	**5**
VI	**Implementation, Integration, and Emerging Trends** Vision system architecture for robots, Embedded vision systems (Nvidia Jetson, Raspberry Pi, Robotics CPUs), ROS/ROS2–based computer vision workflow Integration with robotic arms/mobile robots, Dataset creation, annotation tools, evaluation metrics, Ethics, safety & responsible AI in robotics	**5**
		Total Hrs : 30
List of Laboratory Experiments/ Practicals (if applicable)		
Course Assessment Plan (***for total 60 learning hours)***		

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Design Thinking Exercises	Ideation challenges	**20**	**10**	**3**
MSE	**2**	Short Quizzes / Unit Tests	Concept-based MCQs	**30**	**5**	**9**
ESE	**3**	Mini-Project	Small application-oriented projects which includes design, coding, testing, and report preparation	**30**	**15**	**13**
	4	Case Study Presentation	Industry-oriented problem statements	**10**	**10**	**11**
	5	Oral/Viva Exam	Concept understanding	**10**	**10**	**13**
			Total	**100**	**60 hrs**	

Text Books	
1	David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Prentice Hall, 2003.
2	Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012
3	Roland Siegwart & Illah R. Nourbakhsh, “Introduction to autonomous mobile robots”, Prentice Hall of India, 2004.
4	

References	
1	Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
2	Richard Szeliski: “Computer Vision : Algorithms and Applications”, 2010 Springer.
3	Milan Sonka,VaclavHlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" 3rd Edition, Cengage Learning, 2008.

Useful Links	
1	https://onlinecourses.nptel.ac.in/
2	https://github.com/ajaygunalan/Robotics-Courses
3	https://www.theconstruct.ai/robotigniteacademy_learnros/ros-courses-library/opencv-basics-for-robotics/

7MD370 Financial Modelling 2 0 1 0 3

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM – FinTech)
Class, Semester	Third Year B. Tech. SEM-VI
Course Code	7MD370
Course Name	Financial Modelling
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. **To develop proficiency in Advanced Excel and Python tools** for financial modeling, data analysis, dashboards, and automation in finance-related decision-making.
2. **To build strong foundations in financial mathematics and statistics**, enabling learners to apply time value of money, risk analysis, and data interpretation in real-world financial problems.
3. **To enable learners to construct integrated financial models**, including project cash flows, working capital, valuation models, and financial statement linkages.
4. **To equip learners with practical FinTech and entrepreneurial finance skills**, including SaaS metrics, startup valuation, cap table modeling, funding strategies, and exit analysis

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Apply advanced Excel functions (Goal Seek, Data Tables, Lookup, Index–Match, logical functions, Pivot Tables, dashboards) and Python add-ins to analyze and visualize financial data.	Understanding	2
CO2	Analyze financial problems using concepts of time value of money, compounding, NPV, discount rates, and statistical measures to interpret financial and stock market data.	Analysing	4
CO3	Construct and integrate financial models linking income statement, balance sheet, and cash flow statements, and evaluate firm value using DCF, WACC, and free cash flow approaches..	Evaluating	5
CO4	Design startup financial models including SaaS metrics (CAC, LTV, MRR, ARR), cap table and dilution analysis, funding rounds, and exit strategies for entrepreneurial decision-making.	Creating	6

CO – PO mapping

	Programme Outcomes (PO)										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2				2	2				
CO2	3	2	2			2	2				
CO3	3	3	2								
CO4	2	3	2			2	2				

Module	Module Contents	Hours
I	**Advanced Excel for Financial Modeling** Goal Seek Data Tables Scenario Manager, Introduction to the look function category, H look application case, Index function and Match function to counter, Logical operator in excel and its use in financial Modeling, Sum if functions, Pivot, Slicer and dashboard using excel, Python add-in for Excel	4
II	**Mathematics and statistics for Finance** Introduction to Time value of money and the concept of compounding, present value, Future Value, Rate, Nper, Beg and End calculations, NPV, Discount rate calculation, Introduction to central tendency and application using data, Distribution charts and inferences.	4
III	**Integrated Financial Modeling** Working capital Project cash flows based, on historical metrics Create debt, equity, and working capital supporting schedules, Review how financial statements tie together and balance the model, Integrate the income statement, balance sheet, and cash flow statement in Excel**,** Calculate unlevered free cash flow from the integrated model Discount cash flows using the WACC Derive a share price from total company value	7
IV	Stock Data Analysis and Equity Valuation Stocks Data Analysis, Asset Allocation and Statistical Data Analysis, Predict Future Stock Prices Using Machine/Deep Learning, Perform Sentiment Analysis on Stocks Data Free cash flow calculations, estimation of the cost of equity, calculation of weighted average cost of the capital, valuation using DCF	5
V	**Fintech for Entrepreneur I:** SaaS/Subscription Revenue Modeling: Modeling key FinTech metrics: Customer Acquisition Cost (CAC), Lifetime Value (LTV), Churn Rate, Monthly Recurring Revenue (MRR), Annual Recurring Revenue (ARR). Building a Unit Economics Model in Excel. Early-Stage Valuation Methods.	5
VI	**Fintech for Entrepreneur II:** Cap Table and Dilution Modeling: Calculating dilution across different funding rounds (Seed, Series A). Financing Round Modeling, Waterfall Analysis of exit scenarios , exit strategies for startups, different ways for raising funds, marketing strategies and business plan.	5
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment + Practice Problems	Excel What-if analysis, Lookup functions, TVM problems, basic statistics (Modules I & II)	10	**6 hours**	Week 3
	2	Mini-Task	Working capital components, supporting schedules, financial statement linkages (Module III)	10	**6 hours**	Week 6
MSE	**3**	MCQ Exam	Exam on Modules I–III including numericals and concepts	30	**12 hours**	Week 8
	4	Case-Based presentation	DCF, WACC, stock valuation, SaaS metrics (Modules IV & V)	20	10	12
ESE	**5**	Exam(Online, MCQ based)	Comprehensive exam on Modules I–VI including FinTech entrepreneurship	30	**10 hours**	Week 16
			Total	**100**	**60 hrs**	

Text Books	
1	**Smith, J., Smith, R., & Bliss, R.,** *Entrepreneurial Finance: Strategy, Valuation, and Deal Structure*, **2nd Edition**, Stanford University Press, **2020**.
2	**Damodaran, A.** *Corporate Finance: Theory and Practice*, **4th Edition**, John Wiley & Sons, **2023**.
3	**McKinney, W.** *Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter*, **3rd Edition**, O'Reilly Media, **2022**
4	**Mays, T. R.** *Financial Analysis with Microsoft Excel*, **Latest Edition (Excel 2019/365 compatible)**, Cengage Learning, **2019**.
References	
1	Samonas M. , 2015, Financial Analysis Forecasting and Modelling, A Framework for long-term forecasting, Wiley
2	Damodaran A., The dark side of valuation, Valuing young, distressed, and complex businesses, FtPress
3	
Useful Links	
1	https://corporatefinanceinstitute.com/resources/financial-modeling/three-statement-model/
2	https://corporatefinanceinstitute.com/resources/valuation/time-value-of-money/
3	https://www.geeksforgeeks.org/machine-learning/python-stock-data-visualisation/
4	https://www.datacamp.com/tutorial/finance-python-trading?utm

30. Course Content for Semester VII/VIII

7MD4093	**VII/VIII**	**Deep learning and Generative AI**	**2**	**0**	**1**	**0**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2026-27					
Course Information					
Programme	B. Tech. (MDM – AIML)				
Class, Semester	Final Year - B. Tech., Sem. A/B				
Course Code	7MD409				
Course Name	Deep learning and Generative AI				
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hr/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1Hr/week				
Tutorial	-	30	20	50	100
	-	**Credits: 3**			

Course Objectives	
1	Understand data-driven engineering modeling paradigms using artificial neural networks.
2	Develop architectural intuition for Deep Learning (CNNs, LSTMs) and Generative AI (GANs, Transformers) without heavy mathematical overhead.
3	Apply AI tools directly to domain-specific tasks like visual inspection, time-series sensor diagnostics, and data extraction from technical manuals.
4	Deploy open-source AI models and prompting pipelines safely, with a clear understanding of hallucination risks and ethical constraints.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Prepare and pipeline raw engineering datasets using cleaning, normalization, and validation splitting techniques for neural network training..	III	Apply
CO2	Implement CNN and LSTM networks to solve domain-specific spatial and sequential engineering problems.	III	Apply
CO3	analyze the operational trade-offs between discriminative and generative paradigms for data augmentation and engineering design synthesis.	IV	Analyse
CO4	Design and deploy context-rich prompting pipelines and localized Retrieval-Augmented Generation (RAG) frameworks to securely extract knowledge from unstructured technical documentation.	VI	Create

Programme Outcomes (PO)

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

Module	**Module Contents**	**Hours**

I	**Introduction to Neural Networks & Data Pipelines** Transitioning from traditional engineering modeling to data-driven modeling; biological vs. artificial neurons; linear and non-linear boundaries. structure of a Multi-Layer Perceptron, activation functions, Forward propagation, Loss functions, Cross-validation and handling training issues	5
II	**Computer Vision via Convolutional Neural Networks** Grid Matrices and Spatial Structure, Fundamental CNN Operations, **Non-AIML Domain Engineering Use Cases-** a) Civil Infrastructure: Crack detection and structural integrity profiling from drone footage. b) Mechanical Systems: Automatic visual sorting of components and real-time assembly line surface defect detection.	5
III	**Sequential Data & Predictive Modeling** Chronological & Stream Data Handling, Recurrent Architectures, Long Short-Term Memory Networks, **Non-AIML Domain Engineering Use Cases: -** a) Mechanical/Electrical Maintenance: Predictive failure timelines based on thermal and acoustic sensor histories, b) Chemical/Environmental Engineering: Dynamic forecasting of chemical reaction outcomes or time-series pollutant diffusion over regional grids.	5
IV	**Foundations of Generative AI & Style Transfer** Generative vs. Discriminative Paradigms, Generative Adversarial Networks, Variational Autoencoders & Diffusion Basics, **Non-AIML Domain Engineering Use Cases:** c) Data Augmentation: Manufacturing highly realistic synthetic sensor datasets for rare machinery faults. d) Design & Resolution: Translating low-resolution thermal/infra-red imagery into high-fidelity diagnostic visualizations.	5
V	**Transformers and Large Language Models** The Attention Revolution, Transformer System Layout, Applied Frameworks & Prompt Engineering.	5
VI	**Advanced GenAI Frameworks & Societal Impact** Retrieval-Augmented Generation, Multimodal Frameworks, System Risks and Safety Boundaries **Non-AIML Domain Engineering Use Cases:** a) Multimodal Inspections: Uploading an on-site equipment damage photo to a VLM alongside text queries to generate draft compliance reports. b) Code Co-piloting: Utilizing AI assistance to generate raw script templates (Python, MATLAB) for automating repetitive engineering computations.	5
	Total	30
Assessment		

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz, Crossword etc. using online tools	Continuous Assessment, Knowledge Check, application of basics and analytical skill	10	10hrs	Throughout course
	2	Assignments		10	10hrs	Throughout course
MSE	3	Open Book Exam	Suitable for evaluating comprehension ,analysis, synthesis, and evaluation rather than rote learning.	15	10hrs	Week 9
	4	Group Discussion	Content Relevance and Knowledge, Team Interaction and Collaboration	15	10Hrs	Week 10
ESE	5	Case Study Presentations/ Debating	Analyzing a complex real-world PA implementation and presenting findings/arguments).	30	10 hrs	Weeks 12–13
	6	Oral/Viva Exam	(Assessing conceptual clarity, project knowledge, and communication skills).	20	10hrs	Week 14-15
			Total	**100**	**60 hrs**	**15**

Text Books

1	A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
2	D. Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2023.
3	L. Rice, Prompt Engineering for LLMs: Art and Science. New York, NY, USA: Wiley, 2024.

References

1	I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, Cambridge, MA, USA: MIT Press, 2016. ISBN: 978-0262035613.
2	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Hoboken, NJ, USA: Pearson, 2020. ISBN: 978-0134610993..
3	S. J. Prince, Computer Vision: Models, Learning, and Inference, 2nd ed. Cambridge, U.K.: Cambridge University Press, 2023..

Useful Links

1	https://nptel.ac.in/courses/127108778
2	https://archive.nptel.ac.in/content/syllabus_pdf/106108703.pdf

7MD459 VII/VIII Mini Project 0 0 0 4 2

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2026-27onwards					
Course Information					
Programme	MDM in AIML				
Class, Semester	Final Year B.Tech., A/B				
Course Code	7MD459				
Course Name	Mini-Project				
Desired Requisites:	Fundamentals of Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Natural Language Processing, Programming in Python				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hrs/week	**Credits: 2**			

Course Objectives

The mini-project aims to:

1. Apply the concepts of Artificial Intelligence and Machine Learning learned in the MDM curriculum to solve a practical engineering or societal problem.
2. Develop skills in problem identification, data collection, preprocessing, model development, evaluation, deployment, and validation.
3. Strengthen teamwork, project planning, technical communication, documentation, and presentation skills.
4. Encourage innovation, creativity, ethical AI practices, and interdisciplinary applications of AI and ML technologies.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Analyze real-world problems and formulate suitable AI/ML-based solutions..	Analyze	IV
CO2	Design and develop AI/ML models using modern tools and technologies.	Create	VI
CO3	Implement, validate, and optimize AI/ML systems based on performance metrics.	Evaluate	V
CO4	Demonstrate professional communication, teamwork, documentation, and ethical responsibility in AI/ML project development.	Create	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	3	-	-	2	-	-	-	-	-	2
CO2	1	1	3	-	3	-	-	-	-	1	2
CO3	-	1	1	3	3	-	-	-	-	1	1
CO4	-	-	-	-	-	-	-	2	3	3	1

List of Experiments / Lab Activities

Students will apply Artificial Intelligence, Machine Learning, Deep Learning, Data Analytics, Computer Vision, Natural Language Processing, and Generative AI techniques to develop intelligent solutions for real-world engineering and societal problems.

Group Size: 2 to 3 Students per Project

Projects shall be assessed based on the following points:

1. **Problem Identification and Analysis**
   Identify the problem, define objectives and requirements, conduct a brief literature survey, and study the feasibility of the proposed solution.

2. **System Design and Planning**
   Design the system architecture, select suitable algorithms, tools, datasets, and evaluation metrics, and prepare the project execution plan.

3. **Development and Implementation**
   Collect and preprocess data, develop and train AI/ML models, and implement the proposed system.

4. **Testing and Validation**
   Evaluate system performance using appropriate metrics, analyze results, and refine the solution to meet project objectives.

5. **Documentation and Demonstration**
   Prepare the project report, present the work, demonstrate the developed system, and submit all project deliverables.

Sample AI & ML Project Domains

1. Smart Healthcare Diagnosis System
2. AI-Based Crop Disease Detection
3. Intelligent Traffic Monitoring System
4. Fake News Detection Using NLP
5. Student Performance Prediction
6. Sentiment Analysis of Social Media Data
7. AI-Powered Resume Screening System
8. Smart Energy Consumption Prediction
9. Industrial Predictive Maintenance
10. AI Chatbot for Educational Assistance
11. Computer Vision-Based Safety Monitoring
12. Generative AI Applications for Content Creation

Lab Interactive Hrs : 30
Self Learning Hrs : 30
Total Hrs : 60

Course Assessment Plan (*for total 60 learning hours)*

There are three components of lab assessment, LA1, LA2, and Lab ESE
IMP: Lab ESE is a separate head of passing. Lab ESE is treated as End Semester Exam and is based on overall project activities.

Assessment	Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	1. Problem Identification and Literature Survey 2. Requirement Analysis and Dataset Study 3. Project Planning and Design	LA1 assesses problem identification, literature survey, requirement analysis, dataset selection, and the design and planning of the proposed AI/ML solution.	30	15I + 9SL	Week 6-7
LA 2	1. Model Development and Implementation 2. Testing and Intermediate Results 3. Documentation and Progress Review	LA2 evaluates the implementation progress of the project, including model development, testing, intermediate results, and maintenance of project documentation.	30	15I + 9SL	Week 11-12
ESE	1. Project Demonstration 2. Technical Presentation 3. Project Report 4. Viva-Voce	It assesses the completed project through system demonstration, technical presentation, project report evaluation, and viva-voce examination.	40	12 SL	Week 14
		Total	100	60 hrs	

Text Books	
1	A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022
2	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Hoboken, NJ, USA: Pearson, 2021.
References	
1	F. Chollet, *Deep Learning with Python*, 2nd ed. Shelter Island, NY, USA: Manning Publications, 2021.
2	I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
3	A. C. Müller and S. Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists. Sebastopol, CA, USA: O'Reilly Media, 2016.
Useful Links	
1	https://www.tensorflow.org
2	https://pytorch.org
3	https://www.kaggle.com
4	https://www.kaggle.com

7MD418	VII/VIII	Green Technology and sustainability	2	0	1
0	3				

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM - Smart Cities)
Class, Semester	Final Year Semester A/B
Course Code	7MD418
Course Name	Green Technology & Sustainability
Desired Requisites:	-

Teaching Scheme		Examination Scheme (Marks)			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To introduce the concepts of sustainability, green technologies, and their role in the development of smart cities.
2. To understand sustainable urban infrastructure systems, including energy, water, transportation, and waste management.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the principles of sustainability, smart cities, and green technologies for urban development.	Understanding	L2
CO2	Describe sustainable solutions for urban infrastructure systems, including energy, water, transportation, and waste management.	Understanding	L2
CO3	Apply basic concepts of green building technologies, renewable energy systems, and resource-efficient practices for smart city applications.	Applying	L3
CO4	Assess a building in context as a green building to improve safety, energy efficiency, and sustainability.	Evaluate	L5

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	1				2	3	1		1	
CO2	3	2	2	1		2	3			1	1
CO3	2	2	3	1	2	2	3		1	1	1
CO4	2	3	2	3	2	2	3	1	1	1	1

Module	Module Contents	Hours
I	**Introduction to Sustainability and Smart Cities** Concept of sustainability and sustainable development, United Nations Sustainable Development Goals (SDGs), Principles and characteristics of smart cities, Environmental challenges in urban areas, Green technologies for sustainable urban development, Smart city initiatives in India	5
II	**Sustainable Urban Infrastructure** Sustainable land-use planning, Smart transportation systems, Transit-oriented development (TOD), Intelligent traffic management systems, Sustainable water supply and distribution networks, Urban drainage and flood management	5

III	**Green Energy Technologies for Smart Cities** Energy demand in urban areas, Renewable energy resources and applications, Solar photovoltaic and solar thermal systems, Wind energy and hybrid renewable systems Smart grids and energy-efficient distribution systems, Net-zero energy communities	5
IV	**Green Buildings and Sustainable Construction** Principles of green building design, Green building materials and technologies, Energy-efficient building envelopes, Passive and active energy systems in buildings, Rating systems: IGBC, GRIHA, LEED	5
V	**Sustainable Waste and Resource Management** Integrated solid waste management, Waste-to-energy technologies, Circular economy concepts, Urban wastewater treatment and reuse, Resource recovery and recycling technologies, Smart monitoring systems for waste management	5
VI	**Climate Resilience and Emerging Green Technologies** Climate change impacts on cities, Urban heat island effect and mitigation measures, Internet of Things (IoT) applications in sustainability, Artificial Intelligence for smart city management, Case studies of sustainable and resilient smart cities	5
		Total Hrs: 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hrs	Week
ISE	1	Assignment	Study of smart city initiatives	10	5	3-4
	2	Quiz using Online Tools	Multiple-choice and short-answer questions for assessment of conceptual understanding	10	5	11-12
MSE	3	Group Project	Carbon footprint assessment	15	10	7-8
	4	Digital Poster / Technical Sketch & Presentation	Preparation of sustainability posters	15	10	7-8
ESE	5	Seminar	Student presentations on emerging green technologies related to climate resilience, circular economy, IoT, and AI in smart cities, and circular economy, etc.	25	15	12-13
	6	Case Study Presentation	Green building assessment of a campus building	25	15	13-14
			Total	**100**	**60 hrs**	

Text Books

1	Yudelson, J. (2008). Green Building Design and Construction. New York: McGraw-Hill Education.
2	Pearson, J. M. (2018). Sustainable Urban Development and Smart Cities. Boca Raton, FL: CRC Press.
3	George Tchobanoglous, Hilary Theisen, and Samuel Vigil, "Integrated Solid Waste Management: Engineering Principles and Management Issues", Mc Graw Hill publications, Edition 2014.
4	“Internet of Things – A hands-on approach”, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015

References

1	“Solid Waste Engineering: A Global Perspective”, CL Engineering publications, 3rd edition, 2016
2	Kumar, D. (2023). Renewable Energy Scenarios in Future Indian Smart Cities: A Geospatial Technology Perspective. Singapore: Springer
3	Internet of Things for Smart Cities: Technologies, Big Data and Security by Zaigham Mahmood

4	Kumar, A., & Meshram, D. S. (Eds.). (2022). Sustainable Development Goals and Indian Cities: Inclusion, Diversity and Citizen Rights. New Delhi: Routledge India
5	National Building Code (NBC) 2016.
Useful Links	
1	https://www.youtube.com/watch?v=v93Hfz6Mzbw
2	https://www.youtube.com/watch?v=JyCY5tNhqh8&list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&index=3

7MD468 VII/VIII Mini project 0 0 0 4 2

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in Smart Cities
Class, Semester	Final Year B.Tech., B
Course Code	7MD468
Course Name	Mini-Project
Desired Requisites:	Basic knowledge of Environmental Engineering and Environmental Studies, Fundamentals of Sustainable Development and Natural Resource Management, Elementary knowledge of Smart City concepts and Information & Communication Technologies (ICT).

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hrs/week	**Credits: 2**			

Course Objectives

1. To provide students with an opportunity to apply concepts of green technology and sustainability to real-world urban challenges.
2. To develop skills in data collection, analysis, and assessment of sustainable infrastructure and smart city systems.
3. To encourage the use of modern tools, technologies, and sustainability frameworks for evaluating urban environmental performance.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Discuss sustainability issues related to urban infrastructure, energy, water, waste, transportation, or buildings.	Understanding	II
CO2	Apply appropriate technologies, sustainability indicators, and assessment methods to investigate a selected problem.	Applying	III
CO3	Discuss project findings effectively through technical reports, presentations, and recommendations for sustainable urban development.	Evaluating	V
CO4	Develop feasible and sustainable solutions using engineering principles, modern tools, and resource-efficient practices.	Create	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3	1	1		2	3	1		1	
CO2	2	3	2	3	3	1	3		1	1	1
CO3	1	1	1	1	1	1	2	1	2	3	1
CO4	2	3	3	2	3	2	3	1	2	2	2

List of Experiments / Lab Activities

Students have to focus on applying concepts from green technologies, sustainability indicators, and assessment methods to investigate a selected smart-city problem for a real-world engineering application.

List of Activities:

1. **Water Audit and Conservation Plan:** Conduct a water audit of a campus building and develop a water conservation plan incorporating rainwater harvesting and water-efficient fixtures.
2. **Energy Audit of a Building:** Perform an energy audit of a building and recommend measures to reduce electricity consumption and improve energy efficiency.
3. **Rainwater Harvesting Design:** Design a rainwater harvesting system for a residential building and estimate the annual water savings achieved.
4. **Green Building Assessment:** Assess any academic, residential, or commercial building using GRIHA/IGBC criteria and recommend measures to improve its sustainability performance.

Group of 3 to 4 students per project

Project will be assessed based on the following points;

1. Problem Identification Clarity, and Literature Review
2. Data Collection and Analysis
3. Application of Green Technology and Sustainability Concepts
4. Technical Approach and Methodology
5. Potential for patentability, publications and startup idea
6. Effective use of skill sets, innovation, creativity, and societal usefulness
7. Feasibility and Sustainability of Proposed Solution
8. Contribution of an individual student in the project.
9. Project Report Quality
10. Presentation and Viva

Practical Hrs: 30
Self-Learning Hrs: 30
Total Hrs: 60

Course Assessment Plan (*for total 60 learning hours)*

There are three components of lab assessment: LA1, LA2, and ESE
IMP: ESE is a separate head of passing. ESE is treated as an End Semester Exam and is based on overall project activities.

Assessment	Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	Technical poster Presentation	Problem Identification, Literature Review, and Data Collection	30	12I + 9SL	Week 5-6
LA 2	PowerPoint Presentation	Analysis, Use of Tools, Solution Development, Technical Design (if any)	30	12I + 9SL	Week 10-11
ESE	PowerPoint Presentation and Viva	Report Writing, Presentation, Viva	40	6I + 12 SL	Week 14
		Total	100	60 hrs	

Text Books

1	Vasam, S., & Rao, K. J. (2021). Sustainable Engineering (1st ed.). New Delhi: S. K. Kataria & Sons. ISBN: 978-93-5014-714-6
2	Sharma, P., & Rajput, S. (Eds.). (2017). Sustainable Smart Cities in India: Challenges and Future Perspectives. Cham: Springer.
3	Rag, R. L., & Remesh, L. D. (2022). Introduction to Sustainable Engineering (2nd ed.). New Delhi: PHI Learning Pvt. Ltd. ISBN: 9788120352636.
References	
1	Malik, M., Gupta, M., Jain, S., Singh, S., & Malik, P. (2022). Emerging Technology for Engineers. New Delhi: S. K. Kataria & Sons. ISBN: 978-93-5014-748-1.
2	Sharma, N., Verma, J. P., Gautam, S., Balas, V. E., & Krishnan, S. (Eds.). (2024). Green Computing for Sustainable Smart Cities: A Data Analytics Applications Perspective. Boca Raton: CRC Press.
3	Green Technology (Climate and Innovation). (2025). New Delhi: Khanna Publishing House. ISBN: 978-93-55383-91-4.
4	National Building Code (NBC) 2016
5	Energy Conservation Building Code (ECBC) 2017
6	GRIHA Rating System Manual, IGBC Green Building Rating Systems
7	Smart Cities Mission Guidelines, Government of India
Useful Links	
1	https://www.youtube.com/watch?v=VPU8jxw7yKw
2	https://www.youtube.com/watch?v=oIF9EWyJ2_w

7MD419 VII/VIII Intelligent EV Ecosystems 2 0 1 0 3

Walchand College of Engineering, Sangli

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AY 2025-26 onwards

Course Information

Programme	B. Tech. : MDM in Electrical Vehicles
Class, Semester	Final Year, Sem A/B
Course Code	7MD419
Course Name	Intelligent EV Ecosystems
Desired Requisites:	Basic knowledge of mathematics and statistics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. To understand the need for intelligence in Electric Vehicles (EVs) and identify key smart EV applications enabled by AI, IoT, and data-driven technologies.
2. To Apply data acquisition, preprocessing, and feature engineering techniques to prepare EV data for analytics and intelligent decision-making.
3. To analyze and implement machine learning techniques for solving EV-related problems such as battery management, predictive maintenance, driver monitoring, and autonomous driving.
4. To examine real-world intelligent EV solutions and emerging trends in autonomous and connected vehicle technologies.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	explain intelligent EV architectures, enabling technologies, and connected vehicle ecosystems.	II	Understand
CO2	explain data acquisition, processing, and analytics techniques used in intelligent electric vehicles.	II	Understand
CO3	apply machine learning techniques for battery analytics, fault diagnosis, driver behaviour analysis, and range prediction in EVs.	III	Apply
CO4	analyse advanced AI-based solutions for energy management, predictive maintenance, ADAS, and autonomous driving in electric vehicles.	IV	Analyse

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	1							1		1
CO2	3	2		1	1			2	1		1
CO3	2	2	3	1	3			2	1		1
CO4	2	3	1	2	1			2	1		1

Module	**Module Contents**	**Hours**

I	**Introduction to intelligent EV** Need for Intelligence in EVs, Smart EV Applications: Battery Management Systems, Smart Grid and Charging Integration, Predictive Diagnostics and Maintenance, Driver Assistance Systems (ADAS), Driver Monitoring, Automated Parking, Object Detection, Autonomous Driving, Energy and Route Optimization; Enabling Technologies for Intelligent EVs.	4
II	**EV Sensor Technologies and Connectivity** Role of Sensors in Intelligent EVs, Battery, Vehicle Dynamics and Environmental Sensors, Telematics Systems, Introduction to IoT for Connected EVs, Basics of Networking and Connected Vehicles, Vehicle Communication Protocols (CAN, LIN, V2X), Machine-to-Machine Communication and Interoperability.	5
III	**Data Acquisition and Processing for EVs** EV Data Sources and Characteristics, Data Acquisition from BMS, Sensors, and Telematics Systems, Data Logging and Storage, Data Cleaning and Pre-processing, Data Visualization Techniques, Feature Engineering, Data Normalization, and Standardization	6
IV	**Machine Learning for EV Applications** Introduction to Machine Learning for EVs, **Regression** for SOC/SOH Estimation and Range Prediction, **Classification** for Fault Diagnosis and Driver Behaviour Analysis, **Clustering** and **Outlier Detection** for EV Data Analytics, Model Evaluation and Validation	6
V	**Advanced AI for Intelligent EVs** Introduction to Advanced AI in EVs, **Deep Learning** for Battery Health Prediction and Predictive Maintenance, **Deep Learning** for Object Detection, Driver Monitoring and ADAS, **Reinforcement Learning** for Energy Management and Charging Optimization, AI-enabled Battery Management Systems and Autonomous Driving.	5
VI	**Case study** Intelligent Battery Management Systems, Smart Charging and Energy Management Solutions, Advanced Driver Assistance Systems, Commercial EV Models with Intelligent Features, State-of-the-Art Autonomous Electric Vehicles.	4
		Total Hrs : 30

Course Assessment Plan (*for total 60 learning hours)*

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	1	Quiz / Crossword	Answer a quiz / crossword based on module I and II	10	5	3
	2	Oral / viva	Based on modules IV and V	10	5	9
MSE	3	Group discussion	Discuss in a group based on topic provided	15	5	6
	4	Poster making	Prepare a poster based on topic provided	15	10	7
ESE	5	Case Study Presentations	Prepare a case study based on real-life scenario	30	20	11
	6	Article discussion (Reflection) or Prototype making	Research paper discussion or making oftoy ML based model	20	15	13
			Total	100	60 hrs	

Text Books

1	Hamid, Umar Zakir Abdul. *Autonomous, connected, electric and shared vehicles: Disrupting the automotive and mobility sectors*. SAE International, 2022.
2	Wang, Yinhai, and Ziqiang Zeng. *Data-driven solutions to transportation problems*. Elsevier, 2018.
3	Mahmood, Zaigham. "Connected vehicles in the internet of things." *Cham, Switzerland: Springer* (2020).
References	
1	Möller, Dietmar PF, and Roland E. Haas. *Guide to automotive connectivity and cybersecurity*. Springer International Publishing, 2019.
2	Thorgeirsson, Adam Thor. "Probabilistic prediction of energy demand and driving range for electric vehicles with federated learning." (2024): 190.
Useful Links	
1	https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10559379
2	https://www.mdpi.com/2079-9292/12/4/1044/pdf

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Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26 onwards

Course Information

Programme	MDM in EV
Class, Semester	Final Year B Tech Sem A/B
Course Code	7MD469
Course Name	Mini Project
Desired Requisites:	Introduction to Electric Vehicles, Drives and Control for Electric Vehicles, Embedded Systems for Automotive Applications, Battery Simulation and BMS Modelling Lab

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hrs/week	**Credits: 2**			

Course Objectives

1. To provide students with hands-on experience in solving real-world Electric Vehicle engineering problems.
2. To integrate knowledge of EV powertrains, batteries, embedded systems, communication protocols, and intelligent control systems.
3. To develop skills in system design, modelling, simulation, prototyping, testing, and validation.
4. To promote innovation, entrepreneurship, teamwork, technical communication, and project management skills.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Identify and formulate an engineering problem related to Electric Vehicles.	Applying	III
CO2	Design and develop a hardware/software solution using modern engineering tools.	Analyzing	IV
CO3	Evaluate technical performance, economic feasibility, and sustainability of the developed solution.	Evaluating	V
CO4	Demonstrate project outcomes through technical reports, presentations, and prototype demonstrations.	Creating	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2		2							
CO2	2	3	3	2	3				2		
CO3	2	2	2	3	2	2	2				2
CO4			2		2				3	3	2

Mini Project Activities

Phase I: Problem Identification and Literature Survey

- Identification of EV-related problem statement.
- Literature survey using IEEE, SAE, Springer, Elsevier databases.
- Gap analysis and objective formulation.

Phase II: System Design

- Functional block diagram development.
- Selection of sensors, controllers, batteries, motors, communication protocols, software tools.
- Mathematical modelling and simulation.

Phase III: Implementation

- Hardware prototype development and/or software implementation.
- MATLAB/Simulink, Python, Arduino, ESP32, CAN, BMS tools, Machine Learning tools as applicable.
- Testing and debugging.

Phase IV: Validation and Documentation

- Experimental testing and performance evaluation.
- Technical report preparation.
- Poster, demonstration and final presentation.

Students may select projects from any of the following areas:

EV Powertrain and Drives

1. PMSM drive simulation for EV applications.
2. BLDC motor speed control using PWM.
3. Regenerative braking system modelling.
4. Torque and speed control of EV drive systems.

Battery and Energy Management

5. Battery State-of-Charge estimation.
6. Battery State-of-Health prediction using AI.
7. Passive or Active Cell Balancing System.
8. Battery Thermal Management System.

Embedded Systems and Communication

9. CAN-based EV monitoring system.
10. Smart charging controller using ESP32.
11. Vehicle diagnostics using OBD-II.
12. EV dashboard and telemetry system.

Intelligent EV Systems

13. AI-based charging station recommendation.
14. EV range prediction using Machine Learning.
15. Driver behaviour analysis.
16. Predictive maintenance for EV batteries.

Sustainable Mobility

17. Solar-assisted EV charging station.
18. Vehicle-to-Grid (V2G) energy management.
19. Smart fleet management system.
20. Carbon footprint analysis of EV deployment.

Course Assessment Plan (***for total 60 learning hours***)

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	1	Project Proposal Presentation	Problem identification, literature survey and objectives	15	10	3
	2	Design Review	Architecture, methodology and implementation plan	15	10	6
LA2	3	Progress Review-I	Prototype/simulation development status	15	10	9
	4	Progress Review-II	Testing, validation and analysis	15	10	12
ESE	5	Final Demonstration and Viva	Prototype demonstration and technical evaluation	20	10	14
	6	Project Report and Poster Presentation	Documentation, technical report and poster presentation	20	10	14
			Total	**100**	**60 hrs**	

7MD420	**VII/VIII**	**Data Science and analytics for FinTech**	**2**	**0**	**1**
0	**3**				

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AY 2025-26 onwards

Course Information

Programme	B. Tech. (MDM – FinTech)
Class, Semester	Final Year B. Tech. SEM-VII/VIII
Course Code	7MD420
Course Name	Data Science and analytics for FinTech
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Interaction	1 Hr /week				
Tutorial	-	30	20	50	100
Practical	-	**Credits: 3**			

Course Objectives

1. Understand the role of analytics and statistical methods in modern financial decision-making.
2. Develop the ability to analyze financial time series, volatility, and cash flow trends using quantitative techniques.
3. Apply regression, simulation, and portfolio analytics methods for financial risk assessment.
4. Enable data-driven evaluation of credit risk, fraud detection, and investment decisions.

Course Outcomes (CO)

CO	**Description**	**Blooms Taxonomy**	
		Descriptor	**Level**
CO1	Explain the importance of analytics in finance and identify appropriate statistical tools for financial analysis.	Understanding	2
CO2	Analyze financial time series data to detect trends, volatility, and cash flow patterns.	Analysing	4
CO3	Apply regression models, Monte Carlo simulation, and portfolio analytics to assess financial risk and performance.	Apply	3
CO4	Evaluate credit risk, fraud indicators, and investment scenarios using statistical and analytical techniques.	Evaluate	5

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO2	**3**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**1**
CO4	**2**	**3**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**1**

Module	**Module Contents**	**Hours**
I	**Role of Analytics in Modern Finance:** Introduction to financial analytics and data-driven decision making, Role of analytics in banking, investment, insurance, and FinTech, Types of financial data: market, transactional,	4

	customer, and risk data, Overview of descriptive, predictive, and prescriptive analytics in finance, Key financial performance indicators and analytics use cases	
II	**Time Series Analysis and Trend Detection:** Nature of financial time series data, Trend, seasonality, and cyclical components, Time series visualization and exploratory analysis, Moving averages and exponential smoothing, Cash flow trend analysis using statistical smoothing techniques, Application of time series analysis in financial forecasting	6
III	**Volatility Measurement and Regression Modeling**: Concept of volatility in financial markets, Measurement of volatility using variance and standard deviation, Introduction to regression-based modeling in finance, Simple and multiple linear regression for financial prediction, Interpretation of regression coefficients in financial contexts, Applications in return forecasting and risk estimation	5
IV	**Portfolio Analytics and Risk Assessment**: Portfolio performance tracking and benchmarking, Risk–return trade-off and portfolio diversification, Scenario-based risk assessment concepts, Monte Carlo simulation for portfolio risk analysis, Stress testing portfolios using historical financial data Visualization of portfolio risk metrics	5
V	**Credit Risk and Customer Analytics**: Fundamentals of credit risk and credit scoring, Logistic regression for credit risk scoring, Default probability estimation, Application of clustering techniques in customer financial behavior analysis, Customer segmentation for risk and marketing decisions, Anomaly detection in financial transactions	5
VI	**Financial Risk, Fraud Detection, and Decision Analytics**: Statistical models for detecting financial fraud, Use of statistical distributions in Value-at-Risk (VaR) estimation, Parametric and historical VaR concepts, Hypothesis testing in investment decision-making, Visualization of financial risk indicators and fraud patterns, Ethical and regulatory considerations in financial analytics	5
		Total Hrs : 30

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	Assignment + Practice Problems	Assignment on **Module I & II**: role of analytics in finance, basic financial data interpretation, time series trend identification, moving averages, and cash flow trend analysis using statistical smoothing.	**10**	**6 hours**	Week 3
	2	Mini-Task	Mini-task based on **Module III**: volatility measurement using statistical techniques and application of regression-based models in financial contexts.	**10**	**6 hours**	Week 6
MSE	**3**	Mid-Semester Examination(MCQ or descriptive)	Written examination covering **Module I, II & III** with conceptual questions on financial analytics, numericals on volatility and regression interpretation, and short analytical problems.	**30**	**12 hours**	Week 8

	4	**Case-Based Written Examination (Application Focused)**	Case-based exam on **Module IV & V**: portfolio performance tracking, benchmarking, Monte Carlo–based scenario analysis, credit risk scoring using logistic regression, and customer behavior clustering concepts.	20	10	12
ESE	**5**	ESE Exam (MCQ or descriptive)	End-semester exam focusing on **Module IV, V & VI**, including stress testing using historical data, VaR estimation, fraud detection models, hypothesis testing, and visualization of financial risk metrics.	30	**10 hours**	Week 16
			Total	**100**	**60 hrs**	

Text Books	
1	**Tsay, R. S.**, *Analysis of Financial Time Series*, John Wiley & Sons, **4th Edition, 2019**.
2	**Hull, J. C.**, *Risk Management and Financial Institutions*, John Wiley & Sons, **5th Edition, 2018**.
3	**Gujarati, D. N., & Porter, D. C.**, *Basic Econometrics*, McGraw-Hill Education, **5th Edition, 2010**.
4	**James, G., Witten, D., Hastie, T., & Tibshirani, R.**, *An Introduction to Statistical Learning with Applications in Python*, Springer, **2nd Edition, 2021**.
References	
1	**Damodaran, A.**, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, John Wiley & Sons, **3rd Edition, 2012**.
2	**McKinney, W.**, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter*, O'Reilly Media, **3rd Edition, 2022**.
3	
Useful Links	
1	https://www.investopedia.com/terms/m/movingaverage.asp
2	https://www.investopedia.com/terms/v/volatility.asp
3	https://corporatefinanceinstitute.com/resources/modeling/monte-carlo-simulation-in-excel/
4	https://www.imf.org/external/pubs/ft/fsa/faq/stress.htm
5	https://www.analyticsvidhya.com/blog/2021/07/a-comprehensive-guide-to-time-series-analysis-in-python/
6	https://www.kaggle.com/learn/finance

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AY 2025-26 onwards

Course Information

Programme	MDM in FinTech
Class, Semester	Final Year B.Tech., B
Course Code	7MD470
Course Name	Mini-Project
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hrs/week	**Credits: 2**			

Course Objectives

1. To understand the concepts, technologies, and business models driving the Financial Technology (FinTech) ecosystem.
2. To develop the ability to apply digital financial tools, data analytics, and emerging technologies in financial services.
3. To analyse FinTech solutions, risks, regulations, and cybersecurity challenges inthe financial sector.
4. To evaluate and design innovative FinTech solutions for real-world financial problems and business opportunities.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the fundamentals of FinTech, digital banking, payment systems, blockchain, and financial innovation.	Understand	II
CO2	Explain the fundamentals of FinTech, digital banking, payment systems, blockchain, and financial innovation.	Applying	III
CO3	Explain the fundamentals of FinTech, digital banking, payment systems, blockchain, and financial innovation.	Analyse	IV
CO4	Explain the fundamentals of FinTech, digital banking, payment systems, blockchain, and financial innovation.	Evaluating	V

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	3	-	-	2	-	-	-	-	-	2
CO2	1	1	3	-	3	-	-	-	-	1	2
CO3	-	1	1	3	3	-	-	-	-	1	1
CO4	-	-	-	-	-	-	-	-	3	3	1

List of Experiments / Lab Activities

Group of 2 to 3 students per project

Project shall be assessed based on following points;
1. Novelty of the problem and Clarity
2. Innovativeness in solutions

3. Cost effectiveness and Societal impact
4. Full functioning of working model project set-up / model / software program as applicable.
5. Potential of patentability, publications and startup idea
6. Effective use of skill sets
7. Effective use of standard engineering norms
8. Contribution of an individuals as member or leader
9. Fluency in written and oral communication
10. Quality of project report

Lab Interactive Hrs : 30
Self Learning Hrs : 30
Total Hrs : 60

Course Assessment Plan (*for total 60 learning hours)*

There are three components of lab assessment, LA1, LA2, and Lab ESE
IMP: Lab ESE is a separate head of passing. Lab ESE is treated as End Semester Exam and is based on overall project activities.

Assessment	Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	Project Proposal, ROS Foundation Activities and Design Review	Assessment of ROS basics (workspace, packages, nodes, simulation), problem identification, literature survey, project objectives, requirement analysis, feasibility study, and preliminary system design. Students shall present the project proposal and demonstrate completion of ROS foundation activities.	30	15I + 9SL	Week 6-7
LA 2	Progress Review and Prototype Demonstration	Assessment of project implementation, ROS integration, simulation/prototype development, subsystem integration, testing, debugging, and progress towards project objectives. Students shall demonstrate a partially or fully functional prototype/simulation and submit progress documentation.	30	15I + 9SL	Week 11-12
ESE	Final Project Demonstration, Report and Viva-Voce	Evaluation based on completion of the project, functionality of the developed system, testing and validation results, innovation, technical report, presentation, demonstration, and individual viva voce.	40	12 SL	Week 14
		Total	100	60 hrs	

Text Books

1	Gomber, P., Koch, J. A., and Siering, M., *Digital Finance and FinTech: Current Research and Future Research Directions*, Springer, Cham, Switzerland, 2017.
2	Chishti, S., and Barberis, J., *The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries*, Wiley, Chichester, UK, 2016.
3	Arner, D. W., Barberis, J. N., and Buckley, R. P., *FinTech, RegTech and the Reconceptualization of Financial Regulation*, Northwestern Journal of International Law & Business, 2017.
References	
1	Hilpisch, Y. J., *Python for Finance: Mastering Data-Driven Finance*, O'Reilly Media, Sebastopol, CA, 2020.
2	Antonopoulos, A. M., *Mastering Bitcoin: Programming the Open Blockchain*, O'Reilly Media, Sebastopol, CA, 2017.
3	Sutton, R., and Barto, A., *Reinforcement Learning: An Introduction*, MIT Press, Cambridge, MA, 2018. (Useful for AI-based trading and robo-advisory projects.)
Useful Links	

7MD421 3 **VII/VIII** **Control of Robotics Systems** **2** **0** **1** **0**

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Course Information

Programme	MDM Robotics & Automation
Class, Semester	Final Year B. Tech., Sem VII/VIII
Course Code	7MD421
Course Name	Control of Robotic Systems
Desired Requisites:	Fundamentals of Robotics and Automation, Robot Kinematics and Dynamics, Computer Vision in Robotics

Teaching Scheme		Examination Scheme (Marks)			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr/week	30	20	50	100
		Credits: 3			

Course Objectives

1	To introduce control system concepts in the context of robotic and automation systems.
2	To develop mathematical models of robotic actuators and motion systems.
3	To analyze stability and performance of robotic control systems.
4	To design classical and advanced controllers for robotic applications.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Develop mathematical models of robotic actuators and robotic systems.	III	Applying
CO2	Analyze time-domain and frequency-domain performance of robotic control systems.	IV	Analyzing
CO3	Evaluate stability and tracking performance of robotic systems.	V	Evaluating
CO4	Design controllers for robotic motion and automation applications.	VI	Creating

CO-PO Mapping

	Programme Outcomes (PO)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2			2						
CO2	3	3	2	2	2						
CO3	3	3	2	3	2						
CO4	3	3	3	3	3						

Module	**Module Contents**	**Hours**
I	**Modeling of Robotic Systems** Review of control system fundamentals, Dynamic modelling of robotic systems, Modelling of DC motors, Servo motors and Stepper motors, Transfer function representation of robotic actuators, Mathematical modelling of robotic joints and electromechanical systems, Introduction to robot motion control architecture	5

II	**State Space Modeling and Analysis** State-space representation of robotic systems, Conversion between transfer function and state-space models, State transition matrix, Solution of state equations, Controllability and observability, State-space modeling of robotic manipulators	5
III	**Time Response Analysis of Robotic Systems** Time-domain specifications, Response of first-order and second-order systems, Tracking and regulation problems in robotics, Position, velocity and acceleration control, Steady-state error analysis, Performance evaluation of robotic servo systems	5
IV	**Stability and Motion Control** Stability concepts in robotics, Routh-Hurwitz stability criterion, Root locus analysis, Gain adjustment for robotic motion control, PID controller design and tuning, Control of robotic joints and positioning systems	5
V	**Frequency Response Methods for Robotics** Frequency-domain analysis, Bode plots, Nyquist stability criterion, Gain margin and phase margin, Robustness considerations in robotic systems Lead, Lag and Lead-Lag compensation	5
VI	**Advanced Control Techniques for Robotics** Trajectory tracking control, Feedforward and feedback control, Computed torque control (Introduction), Adaptive control concepts, Intelligent control: Fuzzy and Neural Network-based control (Overview), Control applications in industrial robots, mobile robots and autonomous systems	5

Course Assessment Plan (***for total 60 learning hours)***

Assessment No.		Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
ISE	**1**	**Quiz / MCQ Test**	**Quiz covering Modules I & II (robotic system modeling, actuators, state-space representation, controllability and observability)**	**10**	**5**	**3**
	2	**Simulation-Based Viva**	**Oral/Viva based on MATLAB/Simulink simulations involving robotic actuators, state-space models and response analysis (Modules III–IV)**	**10**	**5**	**8**
MSE	**3**	**Assignment / Numerical Problem Solving**	**Problems on transfer functions, state-space modeling, transient response, stability analysis, root locus and frequency response methods**	**15**	**5**	**6**

	4	**Controller Design and Performance Analysis**	**Design and comparative analysis of P, PI, PID, Lead and Lag controllers for robotic joint control and trajectory tracking applications**	**15**	**10**	**9**
ESE	**5**	**Case Study Presentation**	**Case study on control architecture of an industrial robot, collaborative robot, mobile robot, AGV, drone or autonomous system covering sensors, actuators and control strategy**	**30**	**20**	**11**
	6	**Mini Project / Simulation Project / Research Article Review**	**Any one of the following: (i) MATLAB/Simulink model of robotic joint control, (ii) Trajectory tracking control of a mobile robot, (iii) PID tuning of servo motor, (iv) State-space control design, (v) Review and presentation of a recent IEEE research paper on robotic control systems**	**20**	**15**	**13**
			Total	**100**	**60 hrs**	

Textbooks	
1	Norman Nise, “Control System Engineering”, John Wiley, Seventh Edition, 2014.
2	I.J. Nagrath and M. Gopal, “Control System Engineering”, Anshan Publishers, Fifth edition, 2008.
References	
1	M Gopal, “Control System Principle & Design”, T.M.H., Fourth Edition, 2012.
2	K Ogata, “Modern Control Engineering”, P.H.I., Fourth Edition, 2002.
3	Dorf and Bishop, “Modern Control System”, Adison Wesley Longman, Eight Edition, 1998.
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106098/

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AY 2025-26 onwards

Course Information

Programme	MDM in Robotics & Automation
Class, Semester	Final Year B.Tech., B
Course Code	7MD471
Course Name	Mini-Project
Desired Requisites:	Fundamentals of Robotics and Automation, Kinematics, Dynamics, Computer Vision, Control, basic Python programming, Awareness of current trends in engineering fields.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-				
Tutorial	-	30	30	40	100
Practical	4 Hrs/week	**Credits: 2**			

Course Objectives

1. Apply the concepts of robotics and automation learned in the MDM curriculum to a practical engineering problem, structured as clearly owned functional sub-systems (mechanics, actuation/embedded, and control, software) working against shared interfaces.
2. Strengthen skills in problem identification, design, implementation, testing, and validation, using standard robotics tools and workflows including ROS 2;
3. Promote teamwork within and across functional sub-teams, technical communication, project planning, and documentation;
4. Encourage innovation, creativity, and interdisciplinary thinking in robotics and automation applications.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain the fundamentals of ROS 2 and simulation environments and analyse and formulate a robotics or automation engineering problem into functional sub-systems (mechanics, actuation/embedded, and control) by identifying requirements, constraints, interfaces, and performance objectives.	Analysing	IV
CO2	Design and develop an appropriate robotics or automation solution within a parallel-team structure, using modern engineering tools and technologies such as ROS 2 (for data exchange, logging, and visualization), simulation environments, suitable sensors, actuators, controllers, algorithms, and software tools, working against pre-agreed sub-system interfaces.	Creating	VI

CO3	Implement, integrate (through defined Integration Gates across sub-teams), and validate the developed system through experimentation, testing, KPI-based performance evaluation, and iterative refinement to meet specified requirements.	Evaluating	V
CO4	Communicate technical findings effectively through project reports, presentations, demonstrations, and technical discussions while collaborating both within a sub-team and across the project's other functional sub-teams.	Creating	VI

CO – PO mapping

	Programme Outcomes (PO)										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	3	-	-	2	-	-	-	-	-	2
CO2	1	1	3	-	3	-	-	-	2	1	2
CO3	-	1	1	3	3	-	-	-	-	1	1
CO4	-	-	-	-	-	-	-	-	3	3	1

List of Experiments / Lab Activities

Each project group works on one of six pre-defined Need Statements; split into three functional sub-teams — Team A (Mechanics & Kinematics), Team B (Actuation & Embedded/Sensing) and Team C (Control & Validation) — each building its own slice of the system against pre-agreed Interfaces (I1 — Configuration and I2 — Runtime) and jointly demonstrating combined functionality at a defined Integration Gate. In addition, every group completes a common ROS 2 foundation track (workspace, packages, nodes, and simulation) and integrates ROS 2 as a data-exchange and visualization layer over the project's runtime interface.

Group of 3 to 5 students per sub-team; each project theme (Need Statement) is shared by three sub-teams (Team A, Team B, Team C) working in parallel

Project shall be assessed based on following points;

- Clarity of the problem: understanding of the assigned Need Statement, and clarity of the sub-team's own scope of work within it.
- Innovativeness in solutions, including creative design/engineering choices made within the stated constraints.
- Cost effectiveness and societal impact of the proposed solution.
- Compliance with agreed Interfaces (I1 — Configuration, I2 — Runtime) and completion of contract tests before connecting to the other sub-teams' work.
- Successful demonstration at the Integration Gate — the three sub-teams' work functioning together as one system, not just the individual sub-team's piece in isolation.
- Performance against the project's KPI Scorecard — how close the measured results come to (or exceed) the stated targets.
- Correct and demonstrated ROS 2 integration — accurate topic/message mapping, and live data shown flowing through ROS 2 during the demo.
- Potential of patentability, publications, and startup idea.
- Effective use of skill sets relevant to the sub-team's role (mechanics / electronics / software) and adherence to standard engineering norms.
- Contribution of individuals as a member or coordinator within the sub-team.

- Fluency in written and oral communication, including the ability to explain both the sub-team's own work and how it fits the overall system.
- Quality of project report and documentation : including interface specifications, contract-test logs, and Predicted-vs-Measured comparisons.

Lab Interactive Hrs : 30
Self Learning Hrs : 30
Total Hrs : 60

Course Assessment Plan (*for total 60 learning hours)*

There are three components of lab assessment, LA1, LA2, and Lab ESE
IMP: Lab ESE is a separate head of passing. Lab ESE is treated as End Semester Exam and is based on overall project activities.

Assessment	Formative Assessment type	Brief Description	Marks	Notional Learning hours	Week
LA1	Project Proposal, ROS 2 Foundation Activities and Sub-team Design Review	Assessment of ROS 2 basics (workspace, packages, nodes, and turtlesim-based simulation) completed identically by all groups; problem identification against the assigned Need Statement; the sub-team's Interface I1 (Configuration) design; requirement analysis and feasibility study. Students shall present their sub-team's design plan and demonstrate completion of the ROS 2 foundation activities.	30	15I + 9SL	Week 6-7
LA 2	Progress Review, Contract Testing and ROS 2 Integration Demonstration	Assessment of sub-team implementation progress, completion of Interface I2 (Runtime) contract tests, ROS 2 integration (bridging the sub-team's runtime data to a ROS 2 topic and demonstrating live visualization via rqt/ros2 topic echo), subsystem testing and debugging, and readiness for the Integration Gate. Students shall demonstrate a partially or fully functional prototype/simulation with live ROS 2 topic data and submit progress documentation.	30	15I + 9SL	Week 11-12
ESE	Final Project Demonstration, Report and Viva-Voce	Evaluation based on the Integration Gate demonstration (all three sub-teams' work connected and functioning together),	40	12 SL	Week 14

		performance against the project's KPI Scorecard, live ROS 2 topic visualization, testing and validation results, innovation, technical report, presentation, demonstration, and individual viva voce covering both the student's own sub-team scope and overall system understanding.			
		Total	100	60 hrs	

Text Books	
1	Joseph, L., *Robot Operating System (ROS) for Absolute Beginners*, Apress, New York, 2018.
2	Quigley, M., Gerkey, B., and Smart, W. D., *Programming Robots with ROS: A Practical Introduction to the Robot Operating System*, O'Reilly Media, Sebastopol, CA, 2015.
References	
1	Fairchild, C. and Harman, T., *ROS Robotics By Example*, Packt Publishing, Birmingham, UK, 2016.
2	Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, Cambridge, UK, 2017.
Useful Links	
1	https://docs.ros.org/en/jazzy/index.html
2	https://wiki.ros.org