SNJB's Late Sau. K. B. Jain College of Engineering, Chandwad (An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune) Curriculum and Evaluation Scheme for Second Year B. Tech. in Artificial Intelligence & Data Science Engineering with Multidisciplinary Minor To be implemented for 2024-28 Batch (With Effect from Academic Year 2025-26)

# **Double Minor Syllabus Offered by Artificial** Intelligence & Data Science **Engineering for Other** Branch Students for SEM III and SEM IV

24-DMC-AD-2-01: Computer Networks					
<b>Teaching</b> Theory: 3	Teaching Scheme:       Credit: 3       Examination Scheme:         Theory: 3 Hours/Week       CIE : 20 Marks       MSE : 20 Marks         SEE : 60 Marks       SEE : 60 Marks				
Prerequisi	tes Courses: Discrete Mathematics and S	Statistics (24-PCC-AD-2-01)			
Companio	n Course:				
Course Ob	jectives:				
<ul> <li>To learn different techniques for framing, error control, flow control and routing</li> <li>To learn different layer protocols in the protocol stacks</li> <li>To understand modern network architectures with respect to design and performance</li> <li>To learn the fundamental concepts of Network Security</li> </ul>					
On comple	etion of the course, learners should be at	ble to			
CO.No	со			BL	
C01	Summarize fundamental concepts of (	Computer Networks, architecture	es, protocols and technologies	2	
CO2	<b>Illustrate</b> the working and functions o	f data link layer		3	
CO3	Analyze the working of different routi	ng protocols and mechanisms		3	
C04	Implement client-server applications	using sockets		4	
C05	Illustrate role of application layer with	h its protocols, client-server arcl	hitectures	3	
CO6	<b>Comprehend</b> the basics of Network Se	ecurity		3	
Course Contents					
Unit I	Introduction to Computer Networks		6 Hours		
Definition	<b>Types of Networks:</b> Local area netw	orks (LAN), Metropolitan area	networks (MAN), Wide area netwo	orks (WAN),	

Wireless networks, Networks Software, Protocol, Design issues for the Network layers. **Network Models:** The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium. **Network Architectures:** Client-Server, Peer To Peer, Hybrid. **Network Devices:** Bridge, Switch, Router, Gateway, Access Point. **Line Coding Schemes:** Manchester and Differential Manchester Encodings, Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

#Exempla	#Exemplar / Case Studies: Implementation of a Scalable LAN for a University Campus				
*Mapping	Mapping of Course Outcomes CO1				
Unit II	Data Link Layer		8 Hours		
Introduction Parity Bits Protocol.W CSMA/CD,	<b>Introduction, Functions and Design Issues:</b> Services to Network Layer, Framing.ARQ strategies: Error detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. <b>Flow Control Protocols:</b> Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.WAN Connectivity: PPP and HDLC. MAC Sub layer: <b>Multiple Access Protocols</b> : Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.				
#Exempla	r/Case Studies: Ethernet and Wireless Pi	otocols in Smart Cities			
*Mapping	of Course Outcomes	C02			
Unit III	Network Layer		8 Hours		
Introduction Protocol: Protocols: Link State	Introduction: Functions of Network layer, Switching Techniques: Circuit switching, Message Switching, Packet Switching. IP Protocol: Classes of IP (Network addressing), IPv4, IPv6,Network Address Translation, Sub-netting, CIDR. Network layer Protocols: ARP, RARP, ICMP, IGMP, Network Routing and Algorithms: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. Routing Protocols: RIP, OSPF, BGP, MPLS, Routing in MANET: AODV, DSR, Mobile IP.				
#Exempla	r/Case Studies: Network Layer Impleme	ntation and Optimization in a Large-Scale	Enterprise		
*Mapping	*Mapping of Course Outcomes CO3				
Unit IV	Transport Layer		7 Hours		
Process to establishm and UDP, S	Process Delivery, Services, Socket Progra nent, Connection release, Flow control ar SCTP, RTP, Congestion control and Quality	Imming, <b>Elements of Transport Layer Pro</b> Id buffering, Multiplexing, Congestion Con 1 of Service (QoS), Differentiated services,	<b>tocols:</b> Addressing, Connection trol, <b>Transport Layer Protocols</b> : TCP TCP and UDP for Wireless networks.		
#Exempla	r/Case Studies: Reliable Data Transfer in	Online Video Streaming Platform Like Ne	tflix, Hotstar		
*Mapping	of Course Outcomes	C04			
Unit V	Application Layer		6 Hours		
Introductic Webmail, F	on, <b>Application Layer Protocols:</b> Domain TP, TELNET, DHCP, SNMP.	Name System, HTTP & HTTPS, FTP, SFTP,	TFTP, SMTP, MIME, POP3,		
#Exempla	r/Case Studies: Study of Application Lay	er protocols using network protocol analyz	zer. e.g. Wireshark		
*Mapping	*Mapping of Course Outcomes CO5				
Unit VI	Security in Network		7 Hours		
Introductic X.800 Sec Asymmetri Overview o	on, Security services, Need of Security, urity Architecture for OSI, Security Poli ic Key Cryptography. <b>Security in Netw</b> of IDS and Firewalls.	Key Principles of Security, Threats and Vu cy and mechanisms, Operational Model ork, Transport and Application: Introduc	Inerabilities, Types of Attacks, ITU-T of Network Security, Symmetric and tion of IPSec, SSL, HTTPS, S/MIME,		
#Exemplar/Case Studies: Securing an E-Commerce Platform Against Cyber Threats					

*Mapping of Course Outcomes	C06	
	Learning Resources	
Text Books		
T1. Fourauzan B.,"Data Communications and Networking",5thEdition,TataMcGraw-Hill,Publications, ISBN:0–07 – 058408 – 7 T2. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson India, 2012.		
Reference Books :		
<ul> <li>R1. 1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204</li> <li>R2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.</li> <li>R3. Douglas E. Comer &amp; M.S Narayanan, "Computer Network &amp; Internet", Pearson Education</li> </ul>		
Additional Resources: (Books, e-Resources)         • <a href="http://people.cs.clemson.edu/~jmarty/courses/kurose/Kurose/KuroseCh1-2.pdf">http://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf</a> • <a href="http://eti2506.elimu.net/Introduction/Books/Data">http://eti2506.elimu.net/Introduction/Books/Data Communications and Networking By</a> • <a href="http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf">http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf</a> • <a href="https://www.tutorialspoint.com/data_communication_computer_network/data_communication_on_computer_network_tutorial.pdf">https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network/data_communication</a>		
MOOC Courses links : <ul> <li><u>https://archive.nptel.ac.in/course</u></li> </ul>	es/106/105/106105081/	

24-DMC-AD-2-02: Cloud Computing					
<b>Teaching S</b> Theory: 3 H	Teaching Scheme:       Credit: 3       Examination Scheme:         Theory: 3 Hours/Week       CIE : 20 Marks       MSE : 20 Marks         SEE : 60 Marks       SEE : 60 Marks				
Prerequisit	es Courses: 24-DMC-AD-2-01: Computer N	etwork Fundamentals			
Companion	Course: -NA				
Course Obj U Ez Ez An Course Out After compl	<ul> <li>Course Objectives:</li> <li>Understand the fundamental concepts, architectures, and terminologies of cloud computing</li> <li>Explore the role of service and data management in Cloud computing and its practical applications.</li> <li>Explore resource management , security, simulator and research trends in cloud computing .</li> <li>Analyze VM resources and Dew , Serverless, Sustainability in cloud environments.</li> </ul>				
CO No.	. CO BL				
C01	Understand cloud computing concepts, architectures, and platforms.         2		2		
C02	Understand service and data management in cloud computing. 2		2		
CO3	<b>Demonstrate</b> resource management and security in the cloud. 3				
C04	Understand cloud computing simulation and research trends in cloud computing.         2				
C05	Apply resource allocation, management	and monitoring in the cloud.		3	
C06	<b>Understand</b> dew, serverless and sustaina	able cloud computing.		2	
11	Claud Commuting Quantizer & Austria		7.11		
	cloud Computing Overview & Archite		/ Hours		
Computing	Introduction to Cloud Computing: Overview of Computing, Cloud Computing (NIST Model), Cloud Computing Architecture: Cloud Computing stack, Service Models (IaaS,PaaS, SaaS); Deployment Model				
#Exemplar/Case Studies: Case Study: Amazon Web Services (AWS) Overview					
*Mapping o	f Course Outcomes	C01			
Unit II	Cloud Service & Data Management		7 Hours		

Service Management: Service Level Agreements( SLA's), Cloud Economics ; Data Management: Looking at Data, Scalability and Cloud Services, Map Reduce, Database and Data Store in Cloud, Large Scale Data Processing.				
<b>#Exemplar/Case Studies:</b> Case Study: Healthcare provider stores patient data securely and implements advanced analytics to gain insights.				
*Mapping of C	ourse Outcomes	CO2		
Unit III	Resource Management and Cloud Sec	urity	7 Hours	
<b>Resource Man</b> <b>Security:</b> Infra Security Issues	<b>Resource Management :</b> Resource Allocation, Load Balancing, Cloud Resource Virtualization: Virtual Machines (VM) vs. Containers, <b>Cloud</b> <b>Security:</b> Infrastructure Security, Data Security and Storage, Identity and Access Management, Access Control, Trust, Reputation, Risk, Security Issues.			
<b>#Exemplar/Ca</b> Case Study: So infrastructure	<b>ise Studies:</b> oftware development company adopts co overhead	ontainers instead of VMs to improve application	on portability and reduce	
*Mapping of C	ourse Outcomes	CO3		
Unit IV	Cloud Models, Simulators and Resear	ch Trends	7 Hours	
<b>Open Source:</b> (GCP), Microsc Fog Computine	<b>Open Source:</b> Openstack, CloudStack, Eucalyptus, Nextcloud <b>Commercial Clouds:</b> Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure, IBM Cloud, Oracle Cloud. <b>Cloud Simulator:</b> CloudSim, iCanCloud, GreenCloud, SimGrid, GridSim <b>Research trend:</b> Fog Computing, Sensor Cloud, Container Technology, Green Cloud, IOT Cloud.			
#Exemplar/Ca Case Study:Sn	<b>ise Studies:</b> nart factory implements Fog Computing	to process sensor data.		
*Mapping of C	ourse Outcomes	C04		
Unit V	VM Allocation, Management & Monitoring 7 Hours			
VM Migration and Applicatio	- Basics Migration strategies, Container ns.	based Virtualization <b>Containers , Kubernete</b>	<b>s, Dockers</b> : Key Features, Advantages,	
<b>#Exemplar/Ca</b> Case Study: D	<b>ise Studies:</b> eploying Microservices on AWS Using Ku	bernetes.		
*Mapping of C	ourse Outcomes	C05		
Unit VI	Dew, Serverless & Sustainable Compu	iting.	7 Hours	
<b>Dew Computing:</b> Introduction, Features, Dew Service Models, Architecture, Application and Challenges. Cloud Computing and Dew. Serverless Computing : Function as a Service(FaaS), Evolution of Serverless, Backend as a Service(Baas), Challenges. AWS lambda, Google Cloud Function, Azure Function. Sustainable Cloud Computing: Introduction, Implication of Reliability on Sustainability, Components and Metrics.				
#Exemplar/Ca Case Study 1: Case Study 2:	<b>ise Studies:</b> Smart city uses Dew Computing to proce Retail company uses AWS Lambda for pr	ess data locally on edge devices for real-time rocessing customer orders in real-time.	traffic management.	

<b>Case Study 3:</b> Data center implementing energy-efficient technologies, such as renewable energy and cooling systems, to improve sustainability.			
*Mapping of Course Outcomes	C06		
	Learning Resources		
Text Books			
<b>T1.</b> " <u>Mastering Cloud Computing</u> " by Buyya Rajkumar, <b>T2.</b> " <u>Cloud Computing: Concepts</u> " by Thomas Erl et al., <b>T3.</b> " <u>Distributed and Cloud Computing: From Parallel P</u> Elsevier Publication 2021, ISBN: 9789381269237.	Edition 1st, Chennai McGraw Hill 2022, ISBN: 978-1-25-902995-0. Edition 1st, Pearson Education India; 2018. Processing to the Internet of Things", Kai Hwang et al., Edition 1st, New Delhi		
Reference Books :			
Reference Books :         R1. "Cloud Computing: A Practical Approach" by Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, Edition 1st, McGraw Hill Education India Private Limited; 2015.         R2. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (IaaS, PaaS, SaaS)" by Michael J. Kavis, Wiley, ISBN 978-1-118-82627-0.         R3. "Amazon Web Services For Dummies" by Bernard Golden, Wiley, ISBN 978-1-118-57183-5.         Additional Resources: (Books, e-Resources)         1. Official Cloud Provider Documentation:         a. AWS Documentation : https://cloud.google.com/docs/         c. Microsoft Azure Documentation : https://learn.microsoft.com/en-us/azure/?product=popular         d. Salesforce Developer Resources : https://docs.openstack.org/2024.2/         b. Eucalyptus Documentation : https://docs.eucalyptus.cloud/eucalyptus/5/			
<ul> <li>MOOC Courses links :</li> <li><u>https://archive.nptel.ac.in/courses/106/105/10610</u></li> <li><u>https://onlinecourses.nptel.ac.in/noc25_cs11/prev</u></li> <li><u>https://www.coursera.org/specializations/cloud-co</u></li> <li><u>https://www.edx.org/learn/amazon-web-services-asition=2</u></li> <li><u>https://cloud.google.com/learn/training?hl=en</u></li> </ul>	<u>15167/</u> <u>iew</u> <u>imputing</u> <u>ws/amazon-web-services-aws-cloud-practitioner-essentials?index=undefined&amp;po</u>		

6. <u>https://learn.microsoft.com/en-us/training/azure/</u>

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune) Curriculum and Evaluation Scheme for Second Year B. Tech. in Civil Engineering with Multidisciplinary Minor To be implemented for 2024-28 Batch (With Effect from Academic Year 2025-26)

# Double Minor Syllabus Offered by Civil Engineering for Other Branch Students for SEM III and SEM IV

24-DMC-CE-2-01: Infrastructure Planning and Management					
<b>Teachin</b> Theory:	Teaching Scheme:       Credit: 3       Examination Sch         Theory: 3 Hours/Week       CIE : 20 Marks       MSE : 20 Marks         SEE : 60 Marks       SEE : 60 Marks		Examination Schem CIE : 20 Marks MSE : 20 Marks SEE : 60 Marks	e:	
Prerequ	isites	Courses: -24-ESC-1-04 Smart Buildings	and Materials		
Compan	ion C	ourse: -			
<ul> <li>Course Objectives:</li> <li>To introduce students to the fundamentals of infrastructure development and key sectors such as transportation, power, and telecom.</li> <li>To develop an understanding of financing models, Public-Private Partnerships (PPP), and risk management in infrastructure projects.</li> <li>To equip students with skills in stakeholder management, negotiation, and design thinking for effective project execution.</li> <li>To analyze governance, sustainability, and modern trends in infrastructure development for responsible and future-ready solutions.</li> </ul>					tion, power, frastructure execution. future-ready
Course (	<b>Outco</b> molet	mes:	le to		
CO No			СО		BL
1	<b>Explain</b> the fundamentals of infrastructure development and key sectors.       2		2		
2	Identify and compare financing models and PPPs in infrastructure projects. 3				
3	Analyze economic, construction, political, and social risks in projects.       4				
4	Org	anise stakeholder management, negotia	ation, and design thinking strategies.		3
5	Art	iculate governance, sustainability, and s	socio-economic factors in infrastructure.		3
6	Un	lerstand modern trends, smart technolo	gies, and sustainability in projects.		2
			Course Contents	7.0.	
Unit I		Fundamentals of Infrastructure Plann		/ Hours	
Introduction and Overview of Infrastructure Development, Transportation-Power and Telecom Sectors, Urban vs. Rural Infrastructure, Involvement of Stakeholders and various Phases in an Infrastructure Project					
<ul> <li>#Exemplar/Case Studies:</li> <li>1. Case studies on successful infrastructure projects in Maharashtra and on a global level (i.e Bandra-Worli sea link, Atal Setu, Samruddhi Mahamarg)</li> </ul>					
*Mappir	*Mapping of Course Outcomes CO1				

Unit II	Infrastructure Financing and Partners	hips	8 Hours	
Introduction limitations, Ir (risk vs. returr	Introduction to the requirement and importance of project finance, Public-Private Partnerships (PPP): models, advantages, and limitations, Investment Mechanisms: Government grants, private investments and international funding, Financial Sustainability (risk vs. return in infrastructure investment)			
<b>#Exemplar/C</b> 1. Case Mun	<ul> <li>#Exemplar/Case Studies:</li> <li>1. Case studies on successful urban and rural infrastructure projects, particularly in Maharashtra (i.e infrastructure projects in Mumbai- Pune vs Infrastructure in Chandwad-Malegaon regions)</li> </ul>			
*Mapping of	Course Outcomes	C01, C02		
Unit III	Risk Management in Infrastructure Pr	ojects	8 Hours	
Economic Ris challenges, Po	ks: Cost overruns, inflation, and mark olitical and Social Risks : Policy changes	et fluctuations, Construction Risks: Delays, 1 , land acquisition and public opposition, Regu	esource shortages and technical latory Compliance	
<ul> <li>#Exemplar/Case Studies</li> <li>1. Case Study to discuss the reduction in carbon emissions through project management</li> <li>2. Case studies on risk assessment and analysis of hazardous/old civil structures/buildings (i.e Hazardous buildings in Mumbai)</li> </ul>				
*Mapping of	Mapping of Course Outcomes CO2, CO3			
Unit IV	Stakeholder Engagement and Governa	ance	8 Hours	
Stakeholder Management: Identifying and engaging stakeholders in infrastructure projects, Conflict resolution and negotiation techniques, Role of design thinking in infrastructure solutions, Principles of good governance				
<b>#Exemplar/C</b> 1. Case 2. Grou 3. Case	<b>ase Studies</b> e study on arbitration process and confli- up Activity on Infrastructure Planning an e studies on Smart Cities of India (i.e Dev	ct redressal in infrastructure projects. d Presentation on it velopment of Nashik as a smart city)		
*Mapping of	Course Outcomes	C02, C03, C04		
Unit V	Adaptive Planning		7 Hours	
Adaptive and Flexible Project Planning: Need and Scenario, Best Practices in Infrastructure Development, Resilient Infrastructure, Urban Infrastructures and Smart Cities. Integration of AI-IoT and digital twins in project planning				
Urban Infrasti	Flexible Project Planning: Need and S ructures and Smart Cities. Integration of	cenario, Best Practices in Infrastructure Deve AI-IoT and digital twins in project planning	lopment, Resilient Infrastructure,	
Urban Infrasti #Exemplar/C 1. Case	Flexible Project Planning: Need and S ructures and Smart Cities. Integration of <b>ase Studies:</b> e Studies on Technological Innovations i	cenario, Best Practices in Infrastructure Deve AI-IoT and digital twins in project planning n Infrastructure (AI-enabled smart infrastruct	ures)	
Urban Infrastr #Exemplar/C 1. Case *Mapping of (	Flexible Project Planning: Need and Souctures and Smart Cities. Integration of ase Studies: e Studies on Technological Innovations i Course Outcomes	cenario, Best Practices in Infrastructure Deve AI-IoT and digital twins in project planning n Infrastructure (AI-enabled smart infrastructe <b>CO4, CO5</b>	ures)	
Urban Infrastr #Exemplar/C 1. Case *Mapping of C Unit VI	Flexible Project Planning: Need and Souctures and Smart Cities. Integration of ase Studies: e Studies on Technological Innovations i Course Outcomes Integrated Learning and Future Outlo	cenario, Best Practices in Infrastructure Deve AI-IoT and digital twins in project planning n Infrastructure (AI-enabled smart infrastructu <b>CO4, CO5</b> ok	ures)	
Urban Infrastr <b>#Exemplar/C</b> 1. Case <b>*Mapping of C</b> <b>Unit VI</b> Synthesizing Sustainable Public-Private	Flexible Project Planning: Need and Souctures and Smart Cities. Integration of ase Studies: Studies on Technological Innovations i Course Outcomes Integrated Learning and Future Outlo Key Learnings, Best Practices for In and Green Infrastructure, Global C Innovation Models	cenario, Best Practices in Infrastructure Deve AI-IoT and digital twins in project planning n Infrastructure (AI-enabled smart infrastructor <b>CO4, CO5</b> ok nfrastructure Development, Future Trends hallenges and Opportunities, Infrastructur	Ilopment, Resilient Infrastructure, ures) 7 Hours in Infrastructure Development: re Careers and Specializations,	

### #Exemplar/Case Studies:

- 1. Case Study on Mumbai Metro Expansion A Model for Smart and Sustainable Urban Transport
- 2. Case studies on proposed changes in infrastructure in accordance to Kumbh Mela 2027 at Nashik

*Mapping of Course Outcomes	C06		
	Learning Resources		
Text Books			
<ul> <li>T1. Infrastructure Planning Handbook by Makarand Hastak. Macgraw Hill Professional</li> <li>T2. Urban and Regional Planning: Principles and Practice by Prasanna K. Mohanty, Sage Publications</li> <li>T3. Sustainable Infrastructure: Principles into Practice by Tony Parry and Colin A. Booth, CRC Press</li> </ul>			
Reference Books :			
<ul> <li>R1. Smart Cities Unbundled: Achieving Urban Sustainability through India's Infrastructure Projects by Tan Yigitcanlar and Jason Byrne, Springer</li> <li>R2. Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation by Hudson, Haas Uddin, Macgraw Hill</li> </ul>			
Additional Resources: (Books, e-Resources)			
MOOC Courses links : <ul> <li><u>https://archive.nptel.ac.in/courses/105/106/105106115/</u> (Web)</li> <li>https://archive.nptel.ac.in/courses/105/106/105106188/ (Video)</li> </ul>			

	24-DMC-CE-2-02: Infrastructure Economics				
Teaching Scheme:       Credit: 3       Examination Scheme:         Theory: 3 Hours/Week       CIE : 20 Marks       MSE : 20 Marks         SEE : 60 Marks       SEE : 60 Marks					
Prerequisites Courses: 24-EEM-2-01 Engineering Economics, 24-DMC-CE-2-01 Infrastructure Planning and Management					
Compan	ion Course:				
<ul> <li>Course Objectives:</li> <li>Understand the basics of infrastructure and its role in the economy.</li> <li>Explore the crucial role of infrastructure in fostering economic growth, development, and societal well-being.</li> <li>Analyze the role of infrastructure in driving economic growth and development.</li> </ul>					
After co	mpletion of the course, learners should be	able to			
CO No		CO		BL	
C01	Inspect India's infrastructure policies and development projects. 2				
CO2	Identify financing mechanisms and investment sources.         3				
CO3	Explain infrastructure fundamentals and economic significance.         4				
C04	Interpret the impact of regulations and	foreign investments.		3	
C05	Analyze the link between infrastructure and economic growth.       4				
C06	CO6 <b>Compare</b> India's infrastructure with global benchmarks. 4		4		
Course Contents					
	Unit I Infrastructure Development in India 8 Hours				

infrastructure.

**#Exemplar/Case Studies:** Case Study on Smart Cities Mission, India (Government policies, urban infrastructure, future development trends)

*Mapping of Course Outcomes	C01
-----------------------------	-----

Unit II	Finance for Infrastructure		7 Hours	
Introduction to finance, types of finance, principle of finance, returns on investment, the need for infrastructure finance, sources of infrastructure finance, investment, challenges to get infrastructure finance, infrastructure finance-role of international agencies, types of international finance, different international agencies and their contributions				
<b>#Exempla</b> investmen	<b>r/Case Studies:</b> Case Study on Mumb t sources)	ai Trans Harbour Link (MTHL) (Funding mo	dels, PPPs, financial challenges,	
*Mapping	of Course Outcomes	CO2		
Unit III	Economics & Infrastructure		8 Hours	
Introductio infrastruct policy, Intr	on, meaning of infrastructure, infrastru ure development, importance of infra roduction to MAHA-RERA	cture economics, infrastructure features, typ structure, application of infrastructure econ	es of infrastructure, indicators of omics, Infrastructure and public	
#Exempla	<b>r/Case Studies:</b> Case study on Golden Q	uadrilateral Project, India (Economic impact, o	connectivity, logistics efficiency)	
*Mapping	*Mapping of Course Outcomes CO3			
Unit IV	Infrastructure in an Open Economy		7 Hours	
Open & c account c regulation	close economies, foreign direct investi onvertibility regulatory authorities for s.	ment (FDI) & foreign institutional investme infrastructure development (economics of	ent (FII) in infrastructure, capital f regulations), privatisation and	
<b>#Exempla</b> policy imp	<b>r/Case Studies:</b> Case study on FDI in act)	Indian Telecom Sector (role of foreign inve	stments, economic liberalization,	
*Mapping	of Course Outcomes	C03, C04		
Unit V	Infrastructure and Economic Growth		8 Hours	
Economic growth, measures of economic growth, production function and economic growth, infrastructure and economic growth newly Industrialized countries (NICs), characteristics of NICs, infrastructure development in NICs, lessons from NICs, infrastructure in developing & underdeveloped economies, Introduction to GDP,GNP				
<b>#Exemplar/Case Studies:</b> Case Study on Delhi Metro Expansion (Infrastructure-led economic growth, urban mobility, productivity)				
*Mapping	of Course Outcomes	C05		
Unit VI	A Comparison of Infrastructure in Ind	ia with the World	7 Hours	
Economic prospect f infrastruct	issues in infrastructure development, o or Indian infrastructure, recent achieven ure development	environmental issues, inclusive infrastructure nent, international infrastructure rankings, and	e, make in India & infrastructure, d India's position, future trends in	
<b>#Exemplar/Case Studies:</b> Case study on Bullet Train Project (India-Japan Collaboration) (Global infrastructure benchmarks, technology transfer, investment models)				

*Maping of Course Outcomes	C06				
	Learning Resources				
Text Books					
<b>T1.</b> Sustainable Infrastructure: Principles into Practice by Tony Parry and Colin A. Booth, CRC Press <b>T2.</b> Anu Kapil ", Infrastructure and Economic Development, "Deep & Deep Publications,					
Reference Books :					
<b>R2.</b> T.R.Banga, S.C, Sharma, "Industrial Organization 978-81-7409-078-9	<b>R2.</b> T.R.Banga, S.C, Sharma, "Industrial Organization and Engineering Economics", Khanna Publishers, ISBN No. 978-81-7409-078-9				
R3. V.K.Puri, S.K.Mishra, "Indian Economy", Himala	aya Publishing House, ISBN 978-93-5262-135-4				
R4. Gaurav Datt & Ashvini Mahajan, "Datt & Sund	aram Indian Economy", S.Chand Publishing, ISBN: 978-81-219-0298-4				
Additional Resources: (Books, e-Resources)					
MOOC Courses links : 1. <u>https://archive.nptel.ac.in/courses/109/106/109106089/#</u> 2. <u>https://onlinecourses.nptel.ac.in/noc22_hs64/preview</u>					

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune) Curriculum and Evaluation Scheme for Second Year B. Tech. in Computer Engineering with Multidisciplinary Minor To be implemented for 2024-28 Batch (With Effect from Academic Year 2025-26)

# Double Minor Syllabus Offered by Computer Engineering to Other Branch Students for SEM III and SEM IV

24-DMC-CS-2-01 Foundation of Data Science				
<b>Teaching S</b> Theory: 3 F	Scheme: 5 Hours/Week Credit: 03 Credit: 03 Examination Scheme: CIE: 20 Marks MSE: 20 Marks SEE: 60 Marks		eme:	
Prerequisit	t <b>e Courses:</b> (24-BSC-1-04) Statistics and	I Integral Calculus		
Companior	n Course: NA			
<ul> <li>Course Objectives:</li> <li>Students will be able to: <ul> <li>Understand statistical measures and probability for analyzing data effectively.</li> <li>Create and interpret data visualizations using various charts and graphs.</li> <li>Apply sampling methods and hypothesis testing to make informed decisions.</li> <li>Use correlation techniques to identify relationships between data points.</li> </ul> </li> </ul>				
Course Out	comes: After completion of the course,	learners should be able to		
CO No	СО			BL
<u>C01</u>	Apply statistical measures and graphs to understand data.			3
<u>CO2</u>	Utilize probability and distributions to solve real-life problems.         3			3
03	US         Implement sampling and confidence intervals to study populations.           04         Conduct hypothesis tests to support desision molecular.			3
<u> </u>	14     Conduct hypothesis tests to support decision-making.     4       15     Eventine correlation and variance to identify data patterns.     4			4
				4
		Course Contents		
Unit I	Descriptive Statistics and Data Visual	ization	7 Hours	
Data Classification & Types of Data – Observational data, experimental data, qualitative data (nominal, ordinal), quantitative data (discrete, continuous), types of data in data science (structured, semi-structured, unstructured). Measures of Central Tendency – Mean, median, mode, trimmed mean, data visualization and interpretation. Measures of Variation – Range, interquartile range (IQR), variance, standard deviation, data visualization and interpretation. Measures of Shape – Skewness, kurtosis, data visualization, and interpretation. Measures of Distributions – Percentile, quartile, and decile.				
#Exemplar/Case Studies: Study of Diverse Data Analytics in Ayushman Bharat Yojana, Maharashtra				
*Mapping of Course Outcomes CO1				
Unit II	Probability Theory		8 Hours	
<b>Introduction to Probability Theory</b> – Axioms of probability. <b>Random Variables</b> – Discrete random variable, continuous random variable. <b>Probability Functions</b> – Probability density function (PDF), cumulative distribution function (CDF). Relationship Between PDF and CDF <b>Probability Distributions</b> – Geometric distribution, uniform distribution, exponential distribution. <b>Parameters of Continuous Distributions</b> – Mean, variance, standard deviation, moment-generating functions.				

#Exemplar/Case Studies: Predicting Battery Failure in Electric Vehicles Using Exponential PDF and CDF					
*Mapping of	*Mapping of Course Outcomes CO1, CO2				
Unit III	Estimation Theory		7 Hours		
<b>Population</b> sampling. ( interval est variance.	<b>Population vs. Sample</b> – Population parameter, sample statistic. <b>Sampling Techniques</b> – Probability sampling, non-probability sampling. <b>Central Limit Theorem (CLT)</b> – Concept and applications. <b>Estimation of Population Parameters</b> – Point estimation, interval estimation. <b>Confidence Intervals</b> – Confidence intervals for population mean, population proportion, and population variance.				
#Exemplar	/Case Studies: Survey-Based Estimation	n of Internet Usage Patterns in Urban and Rur	al Areas		
*Mapping o	of Course Outcomes	CO2, CO3			
Unit IV	Hypothesis Testing		8 Hours		
<b>Introductio</b> tests. <b>Error</b> population	n to Hypothesis Testing – Setting up s in Hypothesis Testing – Type I error proportion. t-test – Population variance	a hypothesis test, null and alternative hypo , type II error. <b>z-test</b> – Testing population m e, paired sample t-test, two-sample z and t-test	thesis, one-tailed and two-tailed ean with known variance, testing st.		
#Exemplar	/Case Studies:Hypothesis testing to obs	serve impact of opinion about president based	l on collected poll		
*Mapping o	of Course Outcomes	CO3, CO4			
Unit V	Analysis of Variance		7 Hours		
ANOVA : C One-Way A interaction selection, in	oncept, Need, Definition, underlying as NOVA – Concept, formula, between-gro effects, interpretation of results. Appl mpact on predictive modeling.	ssumptions. <b>Comparison: t-Test vs. ANOVA</b> – oup and within-group variance. <b>Two-Way ANO</b> ications of ANOVA in Data Science & Machi	Key differences and applications. <b>VA</b> – Concept, need, main effects, i <b>ne Learning</b> – ANOVA in feature		
#Exemplar	/Case Studies: ANOVA Analysis of Fever	Recovery Time Across Ethnic Groups and Ger	iders		
*Mapping o	of Course Outcomes	CO4, CO5			
Unit VI	Correlation Analysis		8 Hours		
<b>Correlation Analysis</b> – Concept, importance, applications. <b>Types of Correlation</b> – Pearson correlation (mathematical formulation, assumptions, interpretation), Spearman rank (calculation and use cases), point bi-serial (application in binary and continuous variables), phi-coefficient (use in categorical data analysis). <b>Applications in Data Science &amp; Machine Learning</b> – Feature selection, variable relationships, correlation-driven insights.					
<b>#Exemplar/Case Studies:</b> Correlation Between Social Media Usage and Mental Health					
*Mapping o	*Mapping of Course Outcomes CO5				
Learning Resources					
Text Books					
<b>T1.</b> Applied	l Statistics and Probability for Engineers	(2nd Edition), By Douglas C. Montgomery &	George C. Runger		

T2. Introduction to Probability and Statistics (2nd Edition), By J. Susan Milton & Jesse C. Arnold

#### **Reference Books :**

**R1** By Claus O. Wilke, Fundamentals of Data Visualization, O'REILLY, ISBN: 9781492031086,2019, First Edition **R2**. Wes McKinney, "Python for Data Analysis" O' Reilly media, ISBN: 978-1-449-31979-3.

### Additional Resources: (Books, e-Resources)

- 1. An Introduction to Statistical Learning by Gareth James https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
- 2. Python Data Science Handbook by Jake VanderPlas https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
- 3. Unit-1 Case Study https://hss.iitm.ac.in/ctap/wp-content/uploads/2022/05/IITM-WP3-13-Final-1.pdf
- 4. Unit-2 Case Study https://www.batterypoweronline.com/news/case-study-real-world-battery-failure-prediction/
- 5. Unit-3 Case Study <u>https://pmc.ncbi.nlm.nih.gov/articles/PMC6753815/</u>
- 6. Unit-4 Case Study <u>https://www.sciencedirect.com/science/article/pii/S2772427122001000</u>
- 7. Unit-5 Case Study <u>https://www.kauveryhospital.com/kauverian-scientific-journal/analysis-of-variance-two-way-anova/</u>
- 8. Unit-6 Case Study <u>https://www.kaggle.com/code/souvikahmed071/correlation-between-sm-and-mental-health</u>

### MOOC Courses links :

Link to NPTEL course contents

<u>https://onlinecourses.swayam2.ac.in/imb23\_mg64/preview</u>

24-DMC-CS-2-02 : Principles of Artificial Intelligence and Machine Learning				
<b>Teaching</b> Theory: 3	Aching Scheme: eory: 3 Hours/Week CIE : 20 Marks MSE : 20 Marks SEE : 60 Marks		Examination Scheme: CIE : 20 Marks MSE : 20 Marks SEE : 60 Marks	
Prerequi	sites Courses: (24-DMC-CS-2-01) Founda	tion of Data Science		
Compani	on Course: NA			
Course O	<b>bjectives:</b> To understand traditional AI problems. To acquire fundamentals of problem solvi To learn fundamental concepts of machin	ng, knowledge representation. e learning, regression, classification, clusteri	ng and neural network.	
After com	utcomes: npletion of the course, learners should be	able to		
CO No	CO BL			BL
C01	CO1 <b>Apply</b> search strategies to solve the given problem.			3
C02	CO2 <b>Understand</b> Adversarial Search algorithm and Identify knowledge representation.			2
CO3	CO3 <b>Understand</b> the fundamentals of Machine Learning Concepts.			2
C04	CO4         Apply Regression, Classification and Ensemble Learning algorithms to solve various real world problems.         3			3
CO5	CO5 <b>Apply</b> Clustering algorithms to solve various real world problems. 3			
		Course Contents	l	
Unit I	Introduction to Artificial Intelligence	and Problem Solving	8 Hours	
Overview Best First	of Artificial Intelligence, State Space Se Search, Breadth-First Search, Depth-First	arch, Water Jug Problem, Missionaries and Ca Search, Heuristic Search Hill Climbing.	nibals Problem, <b>Problem S</b>	olving:
#Exempl	ar/Case Studies: Demonstrate how the PE	AS framework is tailored to specific Car-Drivi	ng Tasks	
*Mapping	*Mapping of Course Outcomes CO1			
Unit II	Init II Adversarial Search Algorithms and Knowledge Representation 7 Hours			
Adversarial Search Algorithms: A* Search, AND-OR graph, Constraints Satisfaction Problem, Minimax Search, Alpha Beta Cut Off, Branch and Bound. Knowledge Representation: Introduction, Knowledge Agent, Predicate Knowledge.				
#Exemplar/Case Studies: Alpha Beta Algorithm for improves Chess Game playing.				

*Mapping of	of Course Outcomes	CO2			
Unit III	Introduction to Machine Learning		8 Hours		
Definition Different T Engineerin	Definition of Machine Learning, Classical Machine vs Adaptive Machine, Learning Tasks- Descriptive and Predictive Tasks, <b>Different Types of Learning</b> Supervised, Unsupervised, Semi-supervised and Reinforcement Learnings , <b>Fundamental of Feature</b> <b>Engineering</b> : Feature Selection & Extraction, <b>Inductive Bias</b> : Bias and Variance, Evaluation and Cross-Validation.				
#Exemplar	/Case Studies: Predicting Email spam of	r nonspam using Supervised learning Algorith	m		
*Mapping o	of Course Outcomes	CO3			
Unit IV	Supervised Learning : Regression & C	lassification	7 Hours		
<b>Regression</b> Underfitting Overview o	: Linear Regression, Logistic Regressic g, <b>Classification:</b> Support Vector Mach f Ensemble Methods <b>Ensemble Learnin</b>	on, Residuals and Errors, R-Squared and Adj ine, The Dual Formulation, Nonlinear SVM, <b>g algorithm:</b> Bagging, Boosting, AdaBoost.	usted R-Squared. Overfitting and Kernel function and Kernel SVM.		
#Exemplar	/Case Studies: Predicting Boston House	Prices Prediction Using Linear Regression Alg	jorithm.		
*Mapping o	of Course Outcomes	C03, C04			
Unit V	Unsupervised Learning : Clustering		8 Hours		
Grouping Data Points Based on Similarity, Key Concepts-Distance Metrics (e.g., Pearson Correlation Coefficient, Kernel-based Distances), Cluster Centroids,Intra-cluster and Inter-cluster Distance, <b>Clustering Algorithms:</b> k-means, Agglomerative and adaptive hierarchical clustering, Gaussian mixture model.					
#Exemplar	/Case Studies: Ted Talk Recommendation	on System using Clustering Algorithm.			
*Mapping of	of Course Outcomes	C03, C04			
Unit VI	Neural Networks		7 Hours		
Neural Net Introductio	works: Overview, <b>Perceptron Model:</b> Sin n to Deep Neural Networks.	ngle-layer Perceptron, Multilayer Neural Netw	orks, Backpropagation Algorithm,		
#Case Stud	ly: Google Automatic Translation of Tex	t, words using Neural network			
*Mapping of Course Outcomes		C05			
Text Books					
<b>T1.</b> Deepak Khemani, A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1 <b>T2</b> . Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014.					
Reference	Books :				
<b>R1</b> . Artificia <b>R2.</b> Tom Mi	al Intelligence, Elaine Rich, Kevin Knight tchell, Machine Learning, McGraw Hill, 1	t and Shivashankar B Nair, Third edition, McGr 3rd Edition, 1997.	aw-Hill Education, 2015.		

### Additional Resources: (Books, e-Resources)

- 1. Foundation of Machine Learning: <u>https://cs.nyu.edu/~mohri/mlbook/</u>
- 2. A brief introduction to machine learning for Engineers: <u>https://arxiv.org/pdf/1709.02840.pdf</u>
- 3. Unit-1 Exemplar https://www.geeksforgeeks.org/understanding-peas-in-artificial-intelligence/
- 4. Unit-2 Exemplar <u>https://course.elementsofai.com/2/3</u>
- 5. Unit-3 Exemplar https://www.enjoyalgorithms.com/blog/email-spam-and-non-spam-filtering-using-machine-learning/
- 6. Unit-4 Exemplar <u>https://www.enjoyalgorithms.com/blog/boston-house-price-prediction-using-machine-learning</u>
- 7. Unit-5 Exemplar https://thecleverprogrammer.com/2021/05/27/data-science-case-studies-on-clustering/
- 8. Unit-6 Case Study https://yagyandattamurmu.medium.com/a-case-study-on-google-translate-with-machine-learning-d6e2e0a8a47c

### MOOC Courses links :

- Link to NPTEL course contents: Artificial Intelligence <u>https://onlinecourses.swayam2.ac.in/nou25\_cs07/preview</u>
- Link to NPTEL course contents: Introduction to Machine Learning (IIT Kharagpur): <u>https://onlinecourses.nptel.ac.in/noc22\_cs97/preview</u>

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune) Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor To be implemented for 2024-28 Batch (With Effect from Academic Year 2025-26)

# Double Minor Syllabus Offered by E&TC Engineering for Other Branch Students for SEM III and SEM IV

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

24-DMC-ET-2-01: Digital Electronics				
<b>Teaching Sch</b> e Theory: 3 Hou	Teaching Scheme:       Credit: 3       Examination Scheme         Theory: 3 Hours/Week       CIE : 20 Marks       MSE : 20 Marks         SEE : 60 Marks       SEE : 60 Marks		Examination Scheme: CIE : 20 Marks MSE : 20 Marks SEE : 60 Marks	
Prerequisites	<b>Course:</b> 24-ESC-1-01 : Basic Electrical	& Electronics Engineering.		
Companion C	ourse:			
Course Object To s To p To p To in	<b>tives:</b> Study number systems, Boolean laws & Prepare students to perform the analys ntroduce data converters & microproc	logic gates used in digital systems. is and design of various digital electronic circ essor systems used in digital Systems.	cuits.	
<b>Course Outco</b> After complet	omes: tion of the course, learners should be a	able to		
CO No C	0			BL
CO1 A	CO1 <b>Apply</b> the knowledge of number systems, logic gates & minimization techniques.			3
CO2 <b>Design</b> of Combinational & Logical Logic Circuits.			3	
CO3 L	CO3 <b>Understand</b> A/D & D/A Converters, Semiconductor memories used in digital design. 2			2
CO4 E	Explain organization and architecture of microprocessors2			2
		Course Contents		
Unit I I	ntroduction to Number System & Boo	blean Algebra	8 Hours	
Introduction to Digital System, Signal Types-Analog, Digital, Number System-Decimal, Binary, Octal, Hexadecimal & its conversions. Logic gates & its types, Boolean Algebra-Basic laws of Boolean Algebra. Minimization Techniques-Algebraic & Karnaugh Map (K-Map).				
#Exemplar/C	ase Studies: Application of logic gates	s in seat belt warning system.		
*Mapping of	*Mapping of Course Outcomes CO1			
Unit II C	Combinational Circuits		6 Hours	
Arithmetic cir Comparator, P	Arithmetic circuits-Adder-Half Adder, Full Adder, Ripple carry adder, 4-bit adder, Subtractor, Carry lookahead adder, Magnitude Comparator, Parity generator/checker, Code Converter-BCD to Gray, Gray to BCD.			
#Exemplar/C	#Exemplar/Case Studies: Digital lock System.			

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

*Mapping o	*Mapping of Course Outcomes CO1, CO2				
Unit III	Combinational Logic Design		6 Hours		
Decoder-3: types. Appl	8 bit decoder circuit, Encoder-8 line-3 ications of Multiplexers & Demultiplexe	line encoder, Multiplexers & its types, Multiprs.	olexer trees, Demultiplexers & its		
#Exemplar	<b>/Case Studies:</b> Application of Multiplex	ers used in industrial automations/telecommu	nication.		
*Mapping o	*Mapping of Course Outcomes CO1, CO2				
Unit IV	Sequential Circuits		8 Hours		
Latches & Register, SI Machines.	Flip flop, Clocked SR, JK, MS J-K flip nift register, Universal Shift register, Co	flop, D and T flip-flops. Conversion of Flip unters-Synchronous, Asynchronous, ring cou	flops, Applications of Flip-flops. nter, decade counter, Finite State		
#Exemplar	/Case Studies	Application of Sequential Circuits in Traffic L	ight Control System.		
*Mapping o	of Course Outcomes	C01 ,C02			
Unit V	Data Converters & Semiconductor Me	mories	8 Hours		
Digital to Analog Converter (DAC), Types of DAC-Binary Weighted Resistor, R-2R Ladder, Specification of DAC, Types of error associated with DAC, Application of DAC. Analog to Digital Converter (ADC), Sample & Hold Circuits, ADC Process-Quantization & Coding, Types of ADC-Flash ADC, Dual Slope ADC, Applications of ADC. Semiconductor Memories-Types, Static RAM Dynamic RAM ROM, Types of ROM, Programmable Logic Array (PLA), PAL, FPGA, and CPLD.					
#Exemplar	/Case Studies: ADC system used in Med	ical Applications/Industrial Applications.			
*Mapping o	of Course Outcomes	C03			
Unit VI	Introduction to Microprocessors		6 Hours		
Basic Conc microproce	ept of Microprocessor, Block diagran ssor architecture, pin diagram, address a	n of microprocessor, memory organization, & data busses, Instruction set of 8085 loops.	machine language, Intel 8085		
#Exemplar	/Case Studies: Application of microproc	essor in Mobile Phone/Automobile/Health ca	re/Consumer Electronics.		
*Mapping o	of Course Outcomes	C04			
Learning Resources					
Text Books					
<b>T1.</b> M M 978-0-13-2 <b>T2.</b> R.P. Ja 978007066	orris Mano, Digital Design, 5th Ed 277420-8. ain, Modern Digital Electronics, 4 59116.	dition, 2013, Pearson Education, ISBN-10 th Edition, 2009, Tata McGraw-Hill, ISBN	: 0-13- 277420-8 / ISBN-13: 10: 0070669112 / ISBN 13:		

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

T3. Douglas Hall, SSS P Rao, Microprocessors and its Interfacing (SIE), 3rd Edition, 2017, McGraw Hill, ISBN-10: 9781259006159

### **Reference Books :**

**R1.** Anil Maini, Digital Electronics: Principles and Integrated Circuits, Wiley India Ltd, ISBN: 978-81-265-1466-3. **R2.**Ramesh S.Gaonkar, Microprocessor architecture, programming and applications with the 8085, Fifth edition.

### Additional Resources: (Books, e-Resources)

- https://www.springer.com/gp/book/9783030361952
- <u>https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea</u>

### MOOC/NPTEL Courses links :

- NPTEL Course "Digital Circuits"
   <u>https://archive.nptel.ac.in/courses/108/105/108105113/</u>
- NPTEL Course "Digital Electronic Circuits" <u>https://nptel.ac.in/courses/108/105/108105132/</u>
- Switching Circuits And Logic Design By Prof. Indranil Sengupta: <u>https://swayam.gov.in/nd1\_noc20\_cs67/preview</u>

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

24-DMC-ET-2-02: Microprocessors & Microcontrollers				
<b>Teaching</b> Theory- <b>3</b>	Teaching Scheme:       Credit: 3       Examination Scheme:         Theory-3 Hrs/week       CIE:20 Marks       MSE:20 Marks         SEE:60 Marks       SEE:60 Marks			
Prerequi	sites Courses:24-DMC-ET-2-01: Digital Ele	ctronics		
Compani	ion Course:			
<ul> <li>Course Objectives:</li> <li>To study architecture and features of Microprocessor &amp; Microcontroller.</li> <li>To learn interfacing of real-world peripheral devices with microcontrollers.</li> <li>To Use concepts of timers and interrupts in programming.</li> </ul>				
After con	npletion of the course, learners should be a	able to		
CONo	0			BL
CO1 <b>Understand</b> the fundamentals of Microprocessor & Microcontroller.			2	
CO2 <b>Understand</b> the instruction set and programming of Microprocessor & Microcontroller. 2			2	
CO3	CO3 Interface various electronic components to Microcontrollers. 3			3
C04	<b>Understand</b> the serial communication de	tails and interfaces		2
		Course Contents		
Unit I	Introduction to Microprocessor		7 Hours	
Concept Introduct	of Microprocessor, basics of number systen tion to 8085 microprocessor, architecture δ	n, binary addition, negative binary numbers, b & pin diagram.	asics of computer organ	ization,
#Exempl	lar/Case Studies: 8085 microprocessor in t	raffic light control system.		
*Mappin	g of Course Outcomes	C01		
Unit II	I 8085 Microprocessor 7 Hours			
Memory organization, Address, machine language, assembly language, instruction set, addressing modes, timers, interrupts, basic programming.				
<b>#Exemplar/Case Studies:</b> Digital Clock Using the 8085 Microprocessor				
*Mappin	*Mapping of Course Outcomes CO1,CO2			

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Curriculum and Evaluation Scheme for Second Year B. Tech. in Electronics & Telecommunication Engineering with Multidisciplinary Minor

To be implemented for 2024-28 Batch

(With Effect from Academic Year 2025-26)

Unit III	Introduction to Microcontroller		7 Hours	
Basic Architecture, evolution of microcontrollers, Memory structure, Data Memory, Program Memory, selection criteria of microcontroller, Microcontroller 8051 family, Addressing Modes, Instruction set, basic programming using assembly instructions, Interrupts and Operating Modes.				
#Exemplar	/Case Studies: Identify different microco	ontrollers and their architecture.		
*Mapping o	of Course Outcomes	C01,C02		
Unit IV	Interfacing with Microcontroller 8051		7 Hours	
I/O progran timers, cou	nming, interfacing with simple switch, Ll nters.	ED, Keypad, Relay & LCD programming. Time	rs, various modes of operations of	
#Exemplar,	/Case Studies: Digital Event Counter usi	ng 8051		
*Mapping o	of Course Outcomes	C02, C03		
Unit V	Communication Protocols		7 Hours	
Serial perip programmi	heral interface (SPI), SPI based memory ng, Interrupt understanding and interfac	y interfacing, Universal Serial Communicatior ing, I2C based RTC interfacing , overview of I	ns Interface (USCI) interfacing and Protocols CAN & LIN.	
#Exemplar,	/Case Studies: Embedded Communication	on in Automotive Systems		
*Mapping o	of Course Outcomes	C04		
Unit VI	External Peripheral Interfacing		7 Hours	
Analog to d DAC, Interfa	ligital converter, interfacing with externa acing with stepper motor and DC motor.	al serial and parallel ADC's, Digital to analog	converter (DAC), Interfacing with	
#Exemplar,	/Case Studies: Digital Temperature sens	or using 8051.		
*Mapping o	of Course Outcomes	C02,C03		
Learning Resources				
<b>Text Books:</b> <b>T1</b> . Mazidi Muhammad Ali, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", First Edition, Pearson.				
<b>Reference Books :</b> <b>R1</b> . Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third Edition . <b>R2</b> . Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition				
MOOC Courses links :				

• <u>https://nptel.ac.in/courses/108105102</u>

# Double Minor Syllabus Offered by Mechanical Engineering for Other Branch Students for SEM III and SEM IV

24-DMC-ME-2-01: Introduction to Sustainable Energy Systems			
<b>Teaching Scheme:</b> Theory: 03 Hours/Week	Credit: 03 Lectures: 42	Examination Scheme: CIE: 20 Marks MSE: 20 Marks SEE: 60 Marks	

**Prerequisite courses:** (24-BSC-1-01) Engineering Physics, (24-BSC-1-02) Engineering Chemistry, (24-PCC-ME-1-01) Mechanical Engineering Systems.

#### Companion Course: NA

#### **Course Objectives:**

- To understand the global energy scenario and the challenges associated with conventional energy sources.
- To Understand basic concepts of renewable energy technologies and their role in sustainable energy development.
- To Understand basic concepts and applications of energy storage technologies for efficient and reliable energy systems.
- To understand energy efficiency strategies and the role of smart technologies in achieving conservation.
- To understand the policies and frameworks related to sustainable energy and their impact on global energy practices.
- To understand the effects of climate change on energy systems and explore strategies for carbon emission reduction.

#### **Course Outcomes:**

After completion of the course, learners should be able to

CO No	C0	BL	
CO1. <b>Interpret</b> global energy usage trends, the core aspects of sustainability and how renewable energy supports environmental conservation.			
CO2.	Apply the principles of renewable energy technologies for sustainable energy applications.	2	
CO3.	Utilize energy storage technologies to develop effective solutions for enhancing energy system reliability	3	
CO4.	<b>Demonstrate</b> application of energy efficiency strategies and explain the role of smart technologies in conservation.	3	
CO5. <b>Interpret</b> the effects of renewable energy legislation on sustainable energy transitions and global energy security		2	
CO6. <b>Apply</b> knowledge of climate change impacts to suggest carbon reduction strategies for sustainable energy systems.		3	
	Course Contents		
Unit I	Introduction to Sustainable Energy 7 Hours		
<b>Overview of global energy demand and resources:</b> Global energy demand trends, energy sources, environmental impact of traditional energy systems. <b>Definitions and principles of sustainability:</b> Concepts of sustainability, triple bottom line (economic, environmental, social), importance of sustainable energy systems. <b>Overview of sustainable energy technologies:</b> Brief introduction to renewable energy types (solar, wind, biomass, etc.), role of sustainable technologies in decarbonization.			

<b>#Exemplar/Case Studies:</b> India's Energy Transition towards Renewables					
*Mapping o	f Course Outcomes	C01			
Unit II	Renewable Energy Resources		7 Hours		
Solar ener technologie geotherma pumped sto	<b>Solar energy:</b> Solar radiation basics, photovoltaic (PV) systems, solar thermal systems, concentrating solar power (CSP) technologies. <b>Wind energy:</b> Basics of wind power, wind turbine design and operation, wind energy site selection. <b>Biomass, geothermal, and hydropower systems:</b> Biomass conversion, geothermal power plants, hydropower classification (run-of-river, pumped storage), Hybrid renewable systems.				
#Exemplar,	<b>/Case Studies:</b> Bhadla Solar Park, Rajas	than			
*Mapping o	f Course Outcomes	C02			
Unit III	Energy Storage Technologies		7 Hours		
<b>Importance</b> intermitten trends. <b>The</b> methods (el	e of energy storage: The role of stor t sources. Battery technologies: Lithin rmal energy storage and hydrogen a lectrolysis, steam reforming), Grid-level	rage in renewable integration, as well as ch um-ion batteries, flow batteries, energy den <b>s an energy carrier:</b> Sensible and latent he storage challenges and solutions.	nallenges in storing energy from isity, cycle life, emerging battery eat storage, hydrogen production		
#Exemplar,	/Case Studies: Tata Power's Battery Ene	rgy Storage System (BESS), Delhi			
*Mapping o	f Course Outcomes	CO3			
Unit IV	Energy Efficiency and Conservation		7 Hours		
Concepts of Role of IoT Treatment of	<sup>F</sup> energy efficiency and demand-side m and smart technologies in energy mana on Energy Efficiency)	anagement, Industrial, residential, and comm gement, Behavioral aspects and education fo	nercial energy efficiency practices. r energy conservation. (Numerical		
#Exemplar,	/Case Studies: Energy Efficiency Initiati	ves by EESL (Energy Efficiency Services Limite	ed)		
*Mapping o	f Course Outcomes	C04			
Unit V	Sustainable Energy Policies and Regu	lations	7 Hours		
<b>Global and national policies on renewable energy:</b> Key global agreements (Paris Agreement), national renewable energy action plans (e.g., India's RE policy). Role of governments, Stakeholder roles, NGOs. Financial incentives, carbon trading mechanisms, energy equity considerations, industries in sustainable energy transition.					
#Exemplar,	/Case Studies: National Action Plan on	Climate Change (NAPCC)			
*Mapping o	Mapping of Course Outcomes CO5				
Unit VI	Unit VI Global Warming and its Impacts on Energy Systems 7 Hours				
Climate change and climate modelling: Definition and key concepts of global warming, Historical trends in global temperature rise, Evidence of climate change (melting ice caps, rising sea levels, extreme weather events). Impact of Global Warming on Energy Systems: Changes in energy demand due to climatic shifts, Impacts on renewable energy potential (solar, wind, hydro, and bioenergy), and Vulnerability of fossil fuel infrastructure to climate change. Global Warming and Carbon Emissions: Relationship					

between energy production and carbon footprint, Life-cycle emissions of various energy systems (fossil fuels vs. renewables), Carbon intensity of electricity generation and transport, Carbon capture, utilization, and storage (CCUS).				
#Exemplar/Case Studies: Carbon Sequestration through Afforestation in Madhya Pradesh				
*Mapping of Course Outcomes	C06			
Learning Resources				
Text Books				
<ul> <li>T1. S. P. Sukhatme, "Solar Energy", Tata McGraw-Hill, 2008.</li> <li>T2. G. D. Rai, "Energy Sources", Khanna Publishers, 2009.</li> <li>T3. S. Rao, B. B. Parulekar, "Energy Technology", Khanna Publishers, 2005.</li> <li>T4. D. S. Chauhan, "Non-conventional Energy Resource", New Age International, 2005.</li> </ul>				
<ul> <li>R1. H. C. Singh, "Energy Conservation", Swastik Publications, 2005.</li> <li>R2. H. P. Garg, "Solar Energy", Tata McGraw-Hill, 2000.</li> <li>R3. A.V. Desai, "Non-conventional Energy", New Age International, 2003.</li> <li>R4. Non Conventional Energy Resources, S. K. Dubey, Dhanpat Rai &amp; Co., 2010.</li> </ul>				
<ul> <li>MOOC Courses links :</li> <li>M1. Energy Literacy, <u>https://onlinecourses.swa</u></li> <li>M2. Energy Economics And Policy, <u>https://onlinecourses.nptel.ac.in/noc20_p</u></li> <li>M3. Solar Photovoltaics Fundamentals, Technochttps://onlinecourses.nptel.ac.in/noc20_p</li> <li>M4. Sustainable Energy Technology, <u>https://o</u></li> <li>M5. Sustainable Power Generation Systems, <u>h</u></li> </ul>	ayam2.ac.in/aic22_ge31/preview?utm necourses.nptel.ac.in/noc20_hs68/preview?utm ology And Applications, h21/preview?utm nlinecourses.nptel.ac.in/noc23_me138/preview nttps://onlinecourses.nptel.ac.in/noc23_ge47/preview			

24-DMC-ME-2-02: Solar PV Design Optimization & Manufacturing							
<b>Teaching</b> Theory: C	Scheme: 13 Hours/Week	<b>Credit:</b> 03	Examination Scheme: CIE: 20 Marks MSE: 20 Marks SEE: 60 Marks				
<b>Prerequi</b> Energy Sy	<b>Prerequisites Courses:</b> (24-ESC-1-01) Basic Electrical & Electronics Engineering, (24-HOC-ME-2-01B) Introduction to Sustainable Energy Systems.						
Compani	on Course:						
<ul> <li>Course Objectives:</li> <li>To understand the fundamental principles and applications of solar PV systems.</li> <li>To explain the materials and manufacturing techniques used for solar PV cells and modules.</li> <li>To design efficient and cost-effective solar PV systems using modern tools.</li> <li>To understand techniques to optimize the performance and economics of PV systems.</li> <li>To understand the integration of PV systems with the grid and energy storage solutions.</li> <li>To understand advancements in solar PV technologies.</li> </ul>							
<b>Course Outcomes:</b> After completion of the course, learners should be able to							
CO No	No CO						
C01.	CO1. <b>Understand</b> solar PV cell principles, efficiency metrics, and performance characteristics.						
CO2.	2. <b>Compare</b> material properties and manufacturing processes for quality PV production.						
CO3.	Develop PV systems design using simulation tools and site assessments.						
CO4.	. <b>Apply</b> techniques to enhance PV system efficiency and cost-effectiveness.						
C05.	CO5. <b>Summarize</b> the principles of PV system integration with grid infrastructure and storage solutions for improved energy reliability						
CO6.	Identify emerging solar PV technologies and their potential applications.		2				
Course Contents							
Unit I	Basics of Solar PV Systems		/ Hours				
<b>Introduction to Photovoltaics:</b> Solar radiation fundamentals, photoelectric effect, types of PV systems. <b>Solar Cell Operation:</b> Principles, I-V characteristics, efficiency parameters. PV Modules and Arrays: Series and parallel connections, performance metrics.							
#Exemplar/Case Studies: Rewa Ultra Mega Solar Power Project (Madhya Pradesh)							
*Mapping of Course Outcomes CO1							

Unit II	Solar PV Materials and Manufacturing	7 Hours				
<b>PV Cell Materials:</b> Semiconductor properties, silicon (monocrystalline, polycrystalline), thin-film technologies. <b>Manufacturing</b> <b>Processes:</b> Wafer production, cell assembly, encapsulation, module fabrication. <b>Quality Control:</b> Standards and testing methods for PV modules.						
#Exemplar,	<b>#Exemplar/Case Studies:</b> Tata Power Solar - Bangalore Manufacturing Facility					
*Mapping of Course Outcomes		CO2				
Unit III	Solar PV System Design Principles		7 Hours			
Site Assessment: Solar insolation measurement, shading analysis. System Sizing: Load estimation, inverter selection, battery sizing. Design Tools: Software applications for PV design (e.g., PVsyst, Helioscope etc.)						
#Exemplar,	#Exemplar/Case Studies: Cochin International Airport (Kerala) - World's First Solar-Powered Airport					
*Mapping o	f Course Outcomes	CO3				
Unit IV	Optimization Techniques for PV Syste	ms	7 Hours			
<ul> <li>Performance Optimization: Maximum Power Point Tracking (MPPT), temperature effects, tilt angle adjustments. Economic Optimization: Cost analysis, Levelized Cost of Energy (LCOE), and payback period. Environmental Impact: Carbon footprint reduction, life cycle analysis.</li> <li>#Exemplar/Case Studies: Kamuthi Solar Power Project (Tamil Nadu)</li> </ul>						
*Mapping o	f Course Outcomes	C04				
Unit V	PV Grid Integration and Energy Storag	ge	7 Hours			
<b>Grid-Tied Systems:</b> Net metering, grid codes, power electronics. <b>Energy Storage:</b> Battery technologies, charge controllers, hybrid systems. <b>Challenges and Solutions:</b> Intermittency, grid stability, integration costs.						
<b>#Exemplar/Case Studies:</b> Solar Microgrids in Lakshadweep						
*Mapping o	*Mapping of Course Outcomes CO5					
Unit VI	Emerging Trends and Future of Solar	PV	7 Hours			
<b>Advanced PV Technologies:</b> Bifacial modules, perovskite solar cells, tandem cells. <b>Solar PV Applications:</b> Building-integrated photovoltaics (BIPV), floating solar farms, agrivoltaics. <b>Future Directions:</b> Role in achieving global renewable energy targets and innovations in PV manufacturing.						
<b>#Exemplar/Case Studies:</b> Floating Solar Power Plant on Banasura Sagar Dam, Kerala						
*Mapping of Course Outcomes		CO6				
Learning Resources						
Text Books						

- **T1.** S. P. Sukhatme, "Solar Energy", Tata McGraw-Hill, 2008.
- **T2.** G. D. Rai, "Energy Sources", Khanna Publishers, 2009.
- **T3.** S. Rao, B. B. Parulekar, "Energy Technology", Khanna Publishers, 2005.
- **T4.** D. S. Chauhan, "Non-conventional Energy Resource", New Age International, 2005.

### **Reference Books :**

R1. H. C. Singh, "Energy Conservation", Swastik Publications, 2005.

R2. H. P. Garg, "Solar Energy", Tata McGraw-Hill, 2000.

**R3.** A.V. Desai, "Non-conventional Energy", New Age International, 2003.

R4. Non Conventional Energy Resources, S. K. Dubey, Dhanpat Rai & Co., 2010.

### MOOC Courses links :

- M1. Design of photovoltaic systems, <a href="https://onlinecourses.nptel.ac.in/noc22\_ee71/preview?utm">https://onlinecourses.nptel.ac.in/noc22\_ee71/preview?utm</a>
- M2. Solar Photovoltaics: Principles Technologies & Materials, <u>https://onlinecourses.nptel.ac.in/noc23\_mm10/preview?utm</u>
- M3. Sustainable Energy Technology, <u>https://onlinecourses.nptel.ac.in/noc23\_me138/preview</u>
- M4. Sustainable Power Generation Systems, <u>https://onlinecourses.nptel.ac.in/noc23\_ge47/preview</u>