K. K. Wagh Institute of Engineering Education and Research, Nashik

Curriculum

B.Tech (2022 Pattern)

Electronics and Telecommunication Engineering

w.e.f. AY 2025-2026

K.K.Wagh Institute of Engineering Education and Research,Nashik (Autonomous w.e.f. A.Y.2022-23)

Details of Course Structure:2025-26 Final Year B.Tech (2022Pattern)Semester :VII

Board of Studies in Electronics &Telecommunication Engineering

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	In Sem	End Sem	CCE	TU	TW	PR	OR	Total	TH	TU	PR	Total
ETC224001	DCC	Optical Communication	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ETC224002	DCC	Computer Networks	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ETC224003	DCC	Lab Work Optical Communication	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ETC224004	DCC	Lab Work Computer Networks	-	-	2	-	-	-	-	25	25	-	50	-	-	1	1
ETC224005	DEC	Elective-4:	3	-	-	20	60	20	-	-	-	-	100	3	-	-	3
ETC224006	DEC	Elective-5:	2	-	-	20	30	-	-	-	-	-	50	2	-	-	2
ETC224007	ASM	Research Methodology	2	-	-	20	60	20	-	-	-	-		3	-	-	3
ETC224008	LHSM	Innovation and Entrepreneurship	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
ETC224009	PSI	Project Phase-2	-		8	-	-	-		100	-	50	150	-	-	4	4
		Total	**17**	**1**	**8**	**100**	**300**	**150**	**100**	**100**	**75**		**800**	**17**	**1**	**4**	**22**

Elective --4		Elective –5	
Course Code	**Title of Course**	**Course Code**	**Title of Course**
Communication	MIMO Communication Systems	Signal Processing	Speech & Audio Processing
Automation	Robotics	Advance VLSI Design	VLSI Testing and Testability
Embedded System	Real Time Operating System	Recent trends	Climate change and Green Energy
AI	Deep Learning and Big Data Analysis	e-Mobility	Drives and Control

Name and Sign of BoS Chairman **Sign of Director**

K.K.Wagh Institute of Engineering Education and Research,Nashik (Autonomous w.e.f. A.Y.2022-23)

Details of Course Structure:2025-26 Final Year B.Tech (2022Pattern)Semester :VII

Board of Studies in Electronics &Telecommunication Engineering

Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	In Sem	End Sem	CCE	TU	TW	PR	OR	Total	TH	TU	PR	Total
ETC224011	DCC*	Network Security	**3**	-	-	-	60	40**	-	-	-	-	100	3	-	-	3
ETC224012	DCC*	Elective 6	3	-	-	-	60	40**	-	-	-	-	100	3	-	-	3
ETC224013	LHSM	Financial Literacy	2	-	-	-	-	50	-	-	-	-	50	2	-	-	2
ETC224014	PSI	On-Job Training	-	-	24	-	-	-	-	200	-	100	300	-	-	12	12
		Total	**8**	**-**	**24**	**-**	**120**	**130**	**-**	**200**	**-**	**100**	**550**	**8**	**-**	**12**	**20**

* Considering Internship of 6 months, these courses to be offered in online mode.

** Four Written Assignments/LMS Tests of 10 marks each, will be conducted at the end of each month and one at the end of semester, when students will report for review/presentation of Internship work.

Elective --6	
Course Code	**Title of Course**
Signal Processing	Biomedical Signal Processing
Advance VLSI Design	Mixed Signal Design
Recent trends	Advanced Mobile Communication
e-Mobility	e Mobility and Charging Infrastructure

Name and Sign of BoS Chairman **Sign of Director**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

Final Year B. Tech. Pattern 2022 Semester: VII

ETC224001: Optical Communication

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: Fiber Optic Communication

Companion course, if any: Lab work in Optical Communication

Course Objectives:

1. **Explain** linear and nonlinear effects in optical fiber
2. **Apply** the fundamental knowledge of optical sources and detectors and do the selection of appropriate source and detector in the optical link design for given link length, bit rate, wavelength and fiber specifications
3. **Design** the fiber optic link using power budget and rise time budget.
4. **Illustrate** the optical sensors and optical networks with applications.
5. **Analyze** the performance of optical system using simulation tool.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Comprehend** the light propagation phenomenon inside the optical fiber and reasons behind channel impairments in various types of fibers.	2-Understand
CO2	**Demonstrate** the characteristics of various optical components and their use in optical communication network. (sources, detectors, couplers, isolators, multiplexers, switches, filters, etc.)	3- Apply
CO3	**Understand** the principal of operation of SONET, WDM network, access network and some future optical networking technologies.	2-Understand
CO4	**Solve** network survivability and wavelength routing and assignment problems in optical network.	3- Apply
CO5	**Design and Evaluate** the performance of a fiber optic communication link.	5-Evaluate

COURSE CONTENTS

Unit I	**Introduction to Fiber Optics and Optical Transmission Principles**	**(08 hrs)**	**COs Mapped - CO1**

Introduction: Motivation and evolution of fiber optic system, Elements of optical fiber transmission link; Nature of light-wave theory, ray theory; light wave propagation

Optical Fibers: Types - single mode fiber, multi mode fiber, graded index fiber, photonic crystal fiber; Optical fiber modes and configurations, Signal degradation in optical fiber: Attenuation, Dispersion

Unit II	Optoelectronic Devices: Transmitters and Receivers	(08 hrs)	COs Mapped - CO2

Optical Transmitter: Light Emitting Diode - structure, quantum efficiency and power**;** Laser – laser diode mode and threshold condition, rate equation, quantum efficiency and resonant frequency; Modulation-OOK, SCM.

Optical Detectors: pin photo detector, Avalanche photodiode, Photo detector Noise; demodulation – Direct detection, coherent detection

Unit III	Optical Switches and cross connects	(08 hrs)	COs Mapped – CO3

Optical Network Components: Coupler, Isolator, Multiplexers, Filters, Optical switches, Optical cross connects, Optical amplifiers: EDFA-SOA

Unit IV	Optical Networks	(08 hrs)	COs Mapped – CO4

First generation optical network: SONET/SDH – multiplexing, physical layer, infra structure; Network survivability **Second Generation optical Networks**: WDM networks - Wavelength Assignment and Routing; Access Network: HFC, FTTC, FTTH, access network architecture

Unit V	Fiber measurements & optical sensors	(08 hrs)	COs Mapped – CO5

Fiber Measurements: Attenuation and Dispersion Measurement

Fiber Optic Link Design: Digital Systems: Power budget, rise time budget; Analog systems

Optical Sensors: Classification, measurement of various parameters and sensor applications

Text Books

1. S P Ugale, V Mishra, “Fiber Optic Communication: System and Components”, 2nd Edition, Wiley, 2019.
2. Gerd Kaiser, “Optical fiber communications”, 5th ed. McGraw Hill Int., 2013.
3. Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, “Optical Networks: a practical perspective”, Morgan Kaufmann Publishers, 3nd ed., 2009.

Reference Books

1. G.P. Agrawal, “Fiber-Optic Communication Systems”, Wiley, 4th ed, 2010
2. John Senior, “Optical fiber communications-principles and practices”, Prentice Hall of India, 3rd ed., 2013.
3. J.Gower, “Optical communication systems”, Prentice Hall of India, 2001.
4. Joseph C. Palais, “Fiber Optic Communication”, PEARSON EDUCATION, 5th ed, 2011.
5. Biswanath Mukherjee, “Optical WDM Network”, Springer, 2006

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO3	2	2	2	-	2	-	-	-	-	-	-	-	2	2
CO4	3	3	2	2	3	-	-	-	-	-	-	-	2	3
CO5	3	2	3	2	3	-	-	-	-	2	2	-	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in LMS Tests (5 tests, one on each unit)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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Final Y. B. Tech. Pattern 2022 Semester: VII

ETC224002: Computer Networks

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses, if any: Knowledge of Basic Electronics, Analog Communication, Digital communication.

Course Objectives:

1. Build an understanding of the fundamental concepts & uses of computer networking.
2. To make students able to describe how computer networks are organized with the concept of layered approach.
3. List the layers of the TCP/IP and OSI model and describe the duties of each layer.
4. To develop skills to design simple computer networks.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Explain the concepts of Computer Networks and types of addressing.	2-Understand
CO2	Explain the working of controlling techniques for flawless data communication using data link layer protocols.	2-Understand
CO3	Apply the skills of Network address mapping and sub netting to design the networks.	3-Apply
CO4	Examine the behaviour and performance of data transmission using TCP/UDP Protocols.	2-Understand
CO5	Illustrate the use of protocols at application layer.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to ComputerNetwork and Physical layer**:	**(07 hrs)**	**COs Mapped - CO1**

Definition & Uses of computer Network, Types of networks, Reference models-OSI &TCP/IP protocol suite, network architectures introduction, Addressing types-Physical, Logical & port address, Protocols and Standards. Data rate limits, Transmission media-guided and Unguided, Switching systems, Circuit switching

Unit II	**Data link layer**:	**(07 hrs)**	**COs Mapped - CO2**

Data link control, Framing, Flow & Error control Protocols, noiseless channels, Noisy

channels, Multiple access techniques-random access, controlled access & Channelization protocols, Ethernet types-bridged, Switched, Full duplex, Fast & gigabit Ethernet. Hub, router, repeater, Gateway

Unit III	**Network Layer**	**(09 hrs)**	**COs Mapped – CO3**

Network Layer: network-layer performance- Delay, Throughput, Packet Loss, Congestion Control Concept of IP Address, IPv4 address, IPv6 address, Address mapping-ARP, RARP, IPv4 datagram detail format, IPv6 datagram detail format, IP Address : Netmask, Subnet; CIDR; Design of a LAN; Subnetting Problems. ICMP, IGMP, Network layer issues like Delivery, forwarding, intradomain and Interdomain routing, Routing algorithms like Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Path vector routing

Unit IV	**Transport Layer**:	**(06 hrs)**	**COs Mapped – CO4**

Transport layer: Process to process delivery, Connection oriented & Connectionless Transport, User Datagram Protocol, Transmission Control Protocol, Difference and applications, congestion control and Quality of Service.

Unit V	**Application Layer:**	**(06 hrs)**	**COs Mapped – CO5**

Introduction to Application Layer, Application layer protocols and applications like Ping, FTP, telnet, World Wide Web and HTTP, SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, DHCP,POP,IMAP, E-mail, Introduction of Software-Defined Networking (SDN)

Text Books

1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, 5th Edition.
2. Achyut S Godbole, “Data Communication and Networking”, Tata McGraw-Hill, 1st Edition

Reference Books

1. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education,4 th Edition, 2003

2. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 1st Edition.

3. Greg Tomsho, Ed Tittel, David Johnson. “Guide to Networking Essentials”, Thomson India Learning, 5 th Edition, 2007.

4. William Stallings, “Data and Computer Communication”, Pearson Education, 8th Edition, 2000

5. James F. Kurouse & W. Rouse, “Computer Networking: A Top down Approach”, Pearson Education.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	2	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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Final Year B. Tech.2022 Pattern Semester: VII **ETC224003: Lab work in Optical Communication**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02hrs/week	**01**	**Practical / Oral Exam: 25Marks** **TUT/ TW : 25 Marks**
Prerequisite Courses, if any:		
Companion course, if any: Optical Communication		

Course Objectives:

1. Understand the transmission characteristics of optical fibres and evaluate system losses and performance parameters.
2. Analyze and select appropriate optical sources, detectors, and design optical links for effective communication.
3. Apply link budgeting techniques and use practical field instruments for testing, installation, and maintenance of optical networks.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level (Cognitive domain)**	**Bloom's Level (Psychomotor domain)**
CO1	Explain the transmission characteristics of optical fibers and calculate various system losses and performance parameters.	2-Understand 3-Apply	1-Imitation
CO2	Select suitable optical sources and detectors based on system requirements and design efficient optical communication links.	3-Apply 4- Analyze	2-Manipulation
CO3	Perform link budgeting and use instruments like OTDR for testing, installation, and maintenance of optical fiber networks.	3-Apply	3- Precision

List of Laboratory Experiments		
Sr. No.	**Laboratory Experiments**	**CO Mapped**
1	Determine the numerical aperture of the provided multimode step-index optical fiber.	**CO1**
2	Record and analyze the electrical and optical behavior of a selected optical source .	**CO2**
3	Observe and plot the response characteristics of a chosen photo detector (PN, PIN, or phototransistor).	**CO2**

4	Evaluate the attenuation and bending loss in optical fiber cables.	**CO1,CO2**
5	Set up and demonstrate the transmission of analog signals using an optical communication link.	**CO2**
6	Set up a functioning digital optical communication link.	**CO2**
7	Explore and understand the working of a practical field instrument like an OTDR.	**CO3**
8	Tutorial on optical link budget: optical power and rise time budget of a link to assess system performance.	**CO3**

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Equipment and kits required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Term work Assessment

R1: Timely completion of experiment (10 Marks)
R2: Understanding of experiment (10 Marks)
R3: Presentation / clarity of journal writing (10 Marks)
Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													**CO-PSO Mapping**	
	PO												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	2	-	-	-	-	-	-	-	3	3
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	2	2	-	3	3

K. K. Wagh Institute of Engineering Education and Research, Nashik
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Final Year B. Tech. 2022 Pattern Semester: VII **ETC224004: Lab work in Computer Networks**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02hrs/week	**01**	**Practical Exam: 25 Marks** **Term Work: 25 Marks**
Prerequisite Courses, if any: Knowledge of Basic Electronics, Analog Communication, Digital communication.		
Companion course, if any: Computer Networks		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	To use the networking commands and to implement LAN using simulation software.	2- Understand 3-Apply	2-Manipulation
CO2	To implement various protocols like, DHCP, FTP and RIP using network simulator. Also to implement TELNET and use it.	3-Apply	3-Precision
CO3	Use wireshark software effectively and observe the format of protocols used.	2- Understand 3-Apply	3-Precision

List of Laboratory Experiments		
Sr. No.	**Laboratory Experiments**	**CO Mapped**
1	How can the analysis of fundamental and advanced networkingcommands be used to interpret network behavior, diagnose connectivity issues, and validate protocol configurations based on observed command outputs?	1
2	Implement a LAN using Cisco Packet Tracer by simulating a network with appropriate devices. Design the LAN using a star topology and verify connectivity between two computers within the network.	1
3	Design and configure a LAN with appropriate protocol to automatically assign IP addresses to client devices using Cisco Packet	2

	Tracer.	
4	Considering the requirements for secure and efficient file sharing within a simulated LAN environment, how would you implement and configure an FTP server using Cisco Packet Tracer, and what methods would you use to verify the success of file transfers across multiple client systems?.	2
5	How would you use a network simulator to configure and optimize a router with the RIP routing protocol in a given network topology?	2
6	How would you approach the installation and configuration of a network service like TELNET to enable remote Telnet communication between systems?	2
7	How can you capture and analyze live network traffic from an interface using packet capture tools, and apply various filters to the packets?	3
8	Capture and note the packet of HTTP /FTP /Telnet / DHCP Protocol using Wireshark Packet Analyzer tool.	3

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Equipment and kits required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

R1: Timely completion of experiment (10 Marks)

R2: Understanding of experiment (10 Marks)

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Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	3	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	3	-	-	-	-	-	-	2	3	3
CO3	3	3	-	-	3	-	-	-	-	-	-	2	-	-

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Final Year. B. Tech.Pattern 2022 Semester: VII

ETC224005A: MIMO Communication Systems

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Communication Engineering, Software defined Radio,

Companion course, if any:

Course Objectives:

1. Understand the basic principles and need of MIMO systems
2. Analyze the MIMO system in terms of space-time coding and various beam forming methodologies
3. Channel estimation for single carrier and multiple carrier systems.
4. To identify the role of diversity and MIMO techniques in combating the effect of fading and maximizing the capacity.
5. To cognize the most recent trends in the broad area of wireless communication.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the need for MIMO antenna-based wireless communication systems and distinguish between MIMO and Single Input Single Output (SISO) systems.	2- understand
CO2	Explain the design and working of MIMO transceivers in wireless networks.	2- understand
CO3	**Identify** the role of diversity and MIMO techniques in combating the effect of fading and maximizing the capacity	4- Analyze
CO4	**Analyze** beam forming schemes for MIMO system	4- Analyze
CO5	**Explain** different Advances in MIMO wireless communications.	2- understand

COURSE CONTENTS

Unit I	**Introduction**	**(06 hrs)**	**COs Mapped - CO1**

Review of SISO fading communication channels, MIMO channel models, Classical .i.d. and extended channels, Frequency selective and correlated channel models, Capacity of MIMO channels, Ergodic and outage capacity, Capacity bounds and Influence of channel properties on the capacity

Unit II	**MIMO wireless communication**	**(06 hrs)**	**COs Mapped - CO2**

MIMO channel and signal modeling , A fundamental trade-off, MIMO transceiver design, MIMO in wireless networks, MIMO in wireless standards. Equalizer Noise Enhancement, Equalizer Types, Folded Spectrum and ISIFree Transmission, Linear Equalizers, Zero Forcing (ZF) Equalizers, Minimum Mean Square Error (MMSE) Equalizer, Maximum Likelihood Sequence Estimation., Decision-Feedback Equalization

Unit III	**MIMO Diversity and Spatial Multiplexing**	**(06 hrs)**	**COs Mapped – CO3**

Diversity, Exploiting multipath diversity, Transmit diversity, Delay diversity, Cyclic delay diversity, Space time codes, The Alamouti scheme, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

Unit IV	**MIMO Beam Forming**	**(06 hrs)**	**COs Mapped – CO4**

The generic MIMO problem, Eigenvalues and eigenvectors, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of pre-coding and combining, Codebooks for MIMO, Beam forming principles, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former

Unit V	**Advances in MIMO wireless communications**	**(06 hrs)**	**COs Mapped – CO5**

Spatial modulation, MIMO based cooperative communication and cognitive radio, multiuser MIMO, cognitive-femtocells and large MIMO systems for 5G wireless

Text Books

1. Larsson, Erik G. and Petre Stoica, Space-Time Block Coding for Wireless Communications, Cambridge University Press (2008).
2. Fitzek, Frank H.P., Katz and Marcos D., Cooperation in Wireless Networks: Principles and Applications, Springer (2007).
3. Arogyaswami., Paulraj, Gore, Dhananjay and Nabar, Rohit., Introduction to SpaceTime Wireless Communications, Cambridge University Press (2008)

Reference Books

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press 2005
2. Hamid Jafarkhani, “Space-Time Coding: Theory and Practice”, Cambridge University Press 2005
3. Paulraj, R. Nabar and D. Gore, “ Introduction to Space-Time Wireless Communications”, Cambridge University Press 2003
4. E.G. Larsson and P. Stoica, “Space-Time Block Coding for Wireless Communications”, Cambridge University Press 2008
5. Ezio Biglieri , Robert Calderbank et al “MIMO Wireless Communications” Cambridge University Press 2007

	Strength of CO-PO/PSO Mapping													
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	3

CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3		-	-	-	-	-	-	-	-	-	-	-	3
CO5	3		-	-	-	-	-	-	-	-	-	2	-	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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B. Tech. Pattern 2022 Semester: VII **ETC224005B: Robotics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**
Prerequisite Courses, if any: Mechatronics, Problem solving using Python, Control system		
Companion course, if any: --		
Course Objectives: 1. To Comprehend Fundamental Concepts of Robotics. 2. To Analyze Robot Kinematics and Develop Forward Kinematic Solutions. 3. To Understand Role of drives, grippers in robot design and robot programming Concepts.		

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the fundamentals of robots and robot kinematics.	2
CO2	Explain robot manipulators using forward kinematics, desired end-effector poses using inverse kinematics and plan basic robot trajectories.	2
CO3	Discuss drives and grippers for robotics applications.	2
CO4	Describe the principles of robot dynamics, basic control schemes, and the vision in robotics.	2
CO5	Illustrate advanced concepts in robotics, including robot vision, motion planning, intelligent robots, and robotics programming.	3

COURSE CONTENTS

Unit 1	**Foundations of Robotics**	**(08 hrs)**	**COs Mapped - CO1**

Introduction to Robots:, Definition and Scope of Robotics Automation vs. Robotics, Types of Robots (Industrial, Service, Mobile, etc.), Applications of Robotics in various fields, Robot Anatomy: Manipulators, End Effectors, Actuators, Sensors, Controllers, Robot Configurations: Cartesian, Cylindrical, Spherical, Articulated (Revolute), SCARA, Robot Specifications: Degrees of Freedom (DOF), Workspace, Accuracy, Repeatability, Payload, Introduction to Robot Kinematics:, Coordinate Frames and Transformations Homogeneous Transformations, Rotation Matrices and Translation Vectors

Unit 2	**Robot Forward, Inverse Kinematics & Trajectory Planning**	**(7 hrs)**	**COs Mapped - CO2**

Forward Kinematics:, Denavit-Hartenberg (D-H) Convention

Assigning Coordinate Frames to Robot Links
Derivation of Transformation Matrices, Forward Kinematic Equations for common robot configurations (e.g., 2R, 3R planar, simple serial manipulators), Examples and Problem Solving. **Inverse Kinematics:** Problem Formulation
Existence and Multiplicity of Solutions, Challenges and Limitations of Inverse Kinematics, **Trajectory Planning:**
Joint-Space vs. Cartesian-Space Trajectories, Point-to-Point Motion,

Unit 3	**Robot Drives and Grippers**	**(7 hrs)**	**COs Mapped – CO3**

Drives – Basic types of drives. Advantages and Disadvantages of each type. Selection / suitability of drives for Robotic application. Controllers, Types of Controller and introduction to close loop controller Drives and Control: Understanding drive and control systems for motors, including PWM (Pulse Width Modulation) and other control techniques.Designing and building gear trains and belt drives.

Grippers, Mechanical Gripper-Grasping force, mechanisms for actuation, Magnetic gripper vacuum cup gripper-considerations in gripper selection & design.

Unit 4	**Robot Dynamics, Control, and Sensing**	**(7 hrs)**	**Cos Mapped– CO4**

Robot Dynamics: Introduction to Robot Dynamics**,** Lagrangian Formulation (Qualitative Overview)Joint Torques and Forces, Inertia Matrix, Coriolis and Centrifugal Forces (Conceptual Understanding)
Control Scheme: Open-Loop vs. Closed-Loop Control, Basic Feedback Control Principles (P, PI, PID - Introduction)
Robot Vision: Introduction to Robot Vision**,** Basic Concepts of Image Acquisition, Basic Image Processing Techniques (Thresholding, Edge Detection - Conceptual)**,** Feature Extraction (Introduction)**,** Object Recognition (Basic Concepts)

Unit 5	**Advanced Robotics and Applications**	**(7 hrs)**	**COs Mapped – CO5**

Robot Motion Planning: Path Planning vs. Trajectory Planning**,** Introduction to Motion Planning Algorithms **Intelligent Robots:** Introduction to Artificial Intelligence in Robotics**,** Basic Concepts of Robot Learning and Decision Making
Programming and Languages: Methods of robot programming, Introduction to various languages such as RAIL, VAL II, LISP, Python and MATLAB. Introduction to tools like RoboDK
Summary of Robotics: Review of Key Concepts and Applications**,** Future Trends and Research Directions in Robotics

Text Books

1. Fundamentals of Robotics by D.K. Pratihar, Narosa Publishing House, New-Delhi, 2017
2. Introduction to Robotics: Mechanics and Control (3rd Edition)

Reference Books

1. Robotics by K.S. Fu, R.C. Gonzalez, C.S.G. Lee, McGraw-Hill Book Company, 1987
2. Introduction to Robotics by J.J. Craig, Addison-Wesley Publishing Company, 1986
3. Robotics Modelling, Planning and Control, Bruno Siciliano, Springer

	Strength of CO-PO/PSO Mapping													
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	2	-	3	-	-	-	-	-	3	3	2	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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B. Tech. Pattern 2022 Semester: VII **ETC224005C: Real Time Operating Systems**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**
Prerequisite Courses, if any:. 32 bit Microcontrollers and knowledge of OS		
Companion course, if any: –		
Course Objectives: 1. To learn Programming Concepts 2. To understand RTOS Concepts 3. To learn Structure of uCOS – II 4. To learn Synchronization in µCOS- II 5. To learn Communication in µCOS- II		

Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	**Bloom's Level**
CO1	understand concept of programming concept	2
CO2	understand RTOS Concepts	2
CO3	understand and apply concept multitasking in RTOS	3
CO4	apply concept of semaphore and mutual explosion	3
CO5	apply concept of mailbox, message queue and porting	3
COURSE CONTENTS		
Unit I	**Fundamentals of Software Development**	**COs Mapped - CO1**
Software Architectures, Software Developments Tools, Programming Concepts, Embedded Programming in C and C++, Queues, Stacks, Optimization of Memory needs, Program Modeling Concepts, Software development Process Life Cycle and its Model, Software Analysis, Design and Maintenance		
Unit II	**RTOS Concepts**	**COs Mapped - CO2**
Foreground and background systems, Critical Session, Shared resources, Tasks, Multitasking, Context switching, Kernels, Pre-emptive and non-preemptive Schedulers, Static and Dynamic Priorities, Priority inversion, Mutual exclusion, Synchronization, Inter task communication mechanisms, Interrupts		
Unit III	**Structure of uCOS – II**	**COs Mapped – CO3**

Kernel Structure ,Tasks, Task States, TCB, Ready list, Task Scheduling, Task Level Context Switching, Interrupts, Clock Tick, Initialization, Starting the OS. Task Management, Time Management		
Unit IV	**Synchronization in µCOS- II**	**COs Mapped – CO4**
Semaphore Management,Mutual Exclusion Semaphores, Event Flag Management, Message Mailbox Management, alternate uses of Mailbox. Message Queue Management, Alternate use of Message Queue		
Unit V	**Communication in µCOS- II**.	**COs Mapped – CO5**
Memory Management, Porting of µCOS- II,Case study : Automatic Cruise control system		

Text Books

1. Jean J. Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
2. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, Mc Graw Hill

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	3	-	-	-	-	-	-	2	2	3
CO4	3	3	-	-	3	-	-	-	-	-	-	2	2	3
CO5	3	3	-	-	3	-	-	-	-	-	-	2	2	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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B. Tech. Pattern 2022 Semester: VII **ETC224005D: Deep Learning and Big Data Analysis**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**
Prerequisite Courses, if any:.Basic knowledge of Machine Learning, Programming (Python), and Data Structures.		
Companion course, if any: –		
Course Objectives: 1. To understand the fundamental concepts of Deep Learning and Big Data. 2. To explore various architectures and algorithms in Deep Learning. 3. To comprehend the tools and technologies used in Big Data processing. 4. To apply Deep Learning techniques to Big Data scenarios. 5. To gain hands-on experience with frameworks like TensorFlow, PyTorch, Hadoop, and Spark.		

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the fundamental concepts and evolution of Deep Learning and Big Data, including their real-world applications.	2-Understand
CO2	Explain and analyze neural network architectures and optimization techniques used in deep learning.	3-Apply
CO3	Apply various deep learning models like CNNs, RNNs, LSTMs, and GANs to classification, prediction, and generation tasks.	3-Apply
CO4	Apply Big Data tools such as Hadoop, Spark, and NoSQL databases to process and analyze large datasets in practical scenarios.	3-Apply
CO5	Integrate deep learning models with Big Data technologies for real-time data analytics and develop scalable intelligent applications.	3-Apply

COURSE CONTENTS		
Unit I	**Introduction to Deep Learning and Big Data**	**COs Mapped - CO1**
Overview of Artificial Intelligence, Machine Learning, and Deep Learning. Evolution and history of Deep Learning. Introduction to Big Data: Characteristics (Volume, Velocity,		

Variety, Veracity). Challenges in Big Data processing and analysis. Applications of Deep Learning and Big Data in various domains.

Unit II	**Neural Networks and Optimization Techniques**	**COs Mapped - CO2**

Biological Neuron vs. Artificial Neuron. Perceptron, Multilayer Perceptron (MLP), and Backpropagation algorithm. Activation functions: Sigmoid, Tanh, ReLU, Leaky ReLU. Loss functions: Mean Squared Error, Cross-Entropy. Optimization algorithms: Gradient Descent, Stochastic Gradient Descent, Momentum, RMSProp, Adam.

Unit III	**Deep Learning Architectures**	**COs Mapped – CO3**

Convolutional Neural Networks (CNNs): Architecture, Convolution and Pooling layers, Applications in image processing. Recurrent Neural Networks (RNNs): Architecture, Vanishing Gradient Problem. Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRUs). Autoencoders and Variational Autoencoders (VAEs). Generative Adversarial Networks (GANs): Architecture and applications.

Unit IV	**Big Data Technologies and Tools**	**COs Mapped – CO4**

Hadoop Ecosystem: HDFS, MapReduce, YARN. Apache Spark: RDDs, DataFrames, Spark SQL. NoSQL Databases: HBase, Cassandra, MongoDB. Big Data Streaming: Apache Kafka, Spark Streaming. Data storage and retrieval techniques in Big Data.

Unit V	**Integration of Deep Learning with Big Data**	**COs Mapped – CO5**

Implementing Deep Learning models on Big Data platforms. Distributed training of Deep Learning models using Spark and Hadoop. Case studies: Real-world applications combining Deep Learning and Big Data. Challenges and solutions in integrating Deep Learning with Big Data technologies.

Text Books

1. Goodfellow, I., Bengio, Y., Courville, A. (2016). *Deep learning*. The MIT Press. ISBN-13: 978-0262035613
2. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd ed.). O'Reilly Media. ISBN-13: 978-1492032649
3. Leskovec, J., Rajaraman, A., Ullman, J. (2014). *Mining of massive datasets*. Cambridge University Press. ISBN-13: 978-1107077232
4. Damji, J., Wenig, B., Das, T., Lee, D. (2020). *Learning spark* (2nd ed.). O'Reilly Media Inc. ISBN-13: 978-1492050049

Reference Books

1. *Learning Spark* – Jules Damji, Matei Zaharia.
2. *Natural Language Processingwith Transformer*s – Lewis Tunstall.
3. Murphy, K. (2012). *Machine learning: a probabilistic perspective*. The MIT Press. ISBN-13: 978-0262018029
4. Hastie, T., Tibshirani, R. (2009). *The elements of statistical learning: Data mining, inference, and prediction* (2nd ed.). Springer-Verlag. ISBN-13: 978-0-387-84858-7
5. Han, J., Kamber, M., Pei, J. (2009). *Data mining: Concepts and techniques* (3rd ed.).

Morgan Kaufmann. ISBN-13: 978-9380931913
6. Nudurupati, S. (2021). *Essential PySpark for scalable data analytics: A beginner's guide to harnessing the power and ease of PySpark 3*. Packt Publishing. ISBN-13: 978-1800569722
7. Ramcharan, K., Sundar, K., Alla, S. (2020). *Applied data science using PySpark: Learn the end-to-end predictive model-building cycle*. Apress. ISBN-13: 978-1484257121
8. White, T. (2012). *Hadoop: The Definitive Guide* (3rd or 4th ed.). O'Reilly Media. ISBN-13: 978-1449311520 (for 3rd ed.) / 978-1491901632 (for 4th ed.)
9. Kreps, J., Narkhede, N., Rao, J. (2017). *Kafka: The Definitive Guide*. O'Reilly Media. ISBN-13: 978-1491936160

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	–	–	–	–	–	–	–	–	–	3	–	–
CO2	3	3	–	–	–	–	–	–	–	–	–	–	3	3
CO3	3	3	–	–	3	–	–	–	–	–	–	–	–	3
CO4	3	2	–	–	3	–	–	–	–	–	–	–	3	3
CO5	3	3	–	–	3	–	–	–	–	–	–	3	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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Final Year B. Tech. Pattern 2023 Semester: I
ETC224006A: Speech and Audio Processing

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :02 hrs/week	02	InSem Exam: 20 Marks EndSem Exam: 30 Marks

Prerequisite Courses, if any: Digital signal processing

Companion course, if any:

Course Objectives:

1. Understand the anatomy and physiology of acoustic production and perception model.
2. To analyze the speech in time domain and extract various parameters.
3. To study the concept of Homomorphic system and analyze various audio coding techniques with applications.
4. To study various automatic speech recognition techniques.
5. To analyze various audio coding techniques with applications.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Model an electrical equivalent of Speech Production System	6
CO2	Extract the LPC coefficients that can be used to synthesize or compress the speech..	6
CO3	Design a Homomorphic vocoder for coding and decoding of speech.	3
CO4	Extract the features for automatic speaker recognition systems	6
CO5	Design basic audio coding methods.	3

COURSE CONTENTS

Unit I	Fundamentals of Digital Speech Processing	(09 hrs)	COs Mapped - CO1

Anatomy & Physiology of Speech Organs, The Process of Speech Production, The Acoustic theory of speech production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals. Perception : Anatomical pathways from the Ear to the Perception of Sound, The Peripheral Auditory system, Hair Cell and Auditory Nerve Functions, Properties of the Auditory Nerve. Block schematics of the Peripheral Auditory system

Unit II	Time Domain models for Speech Processing	(10 hrs)	COs Mapped - CO2

Introduction – Window considerations, Short time energy, average magnitude, average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, pitch period estimation using a parallel processing approach, the short time autocorrelation function, average magnitude difference function, pitch period estimation using the autocorrelation function. Basic principles of Linear Predictive Analysis : Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Unit III	Homomorphic Speech Processing	(09 hrs)	COs Mapped – CO3

Introduction, Homomorphic Systems for Convolution: Properties of the Complex

Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder. Speech Enhancement: Speech enhancement techniques: Single Microphone Approach, Spectral Subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi Microphone Approach.			
Unit IV	**Automatic Speech Recognition**	**(08 hrs)**	**COs Mapped – CO4**
Basic pattern recognition approaches, parametric representation of Speech, Evaluating the similarity of Speech patterns, Isolated digit Recognition System, Continuous word Recognition system. Elements of HMM, Training & Testing of Speech using HMM. Automatic Speaker Recognition: Recognition techniques, Features that distinguish speakers, MFCC, delta MFCC, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System And Performance Metrics.			
Unit V	**Audio Coding**	**(05 hrs)**	**COs Mapped – CO5**
Audio Coding, Lossy Audio coding, Psychoacoustics, ISO-MPEG-1 Audio coding, MPEG - 2 Audio coding, MPEG - 2 Advanced Audio Coding, MPEG - 4 Audio Coding.			

Text Books

1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Digital Audio Signal Processing – Udo Zolzer, 2nd Edition, Wiley.
3. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley

Reference Books

1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri, 1st ed., PE.
2. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, PHI.
3. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., EEE Press.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	-	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	-	3	-	-	-	-	-	-	-	-	3
CO5	3	3	3	-	3	-	-	-	-	-	-	-	-	3

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T. Y. B. Tech. Pattern 2023Semester: I **ETC224006B: VLSI Testing and Testability**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02 hrs/week	**02**	**InSem Exam: 20 Marks** **EndSem Exam: 30 Marks**

Prerequisite Courses, if any: Digital Electronics

Companion course, if any: NA

Course Objectives:

1. To introduce the fundamental concepts, importance, and processes of testing and verification in VLSI design, including fault models and test equipment.
2. To provide in-depth knowledge of various test methods, logic and fault simulation techniques, and algorithms used for combinational and sequential circuit testing.
3. To enable students to analyze and implement design-for-testability strategies such as scan architectures, BIST, and analog test techniques for improving circuit testability.
4. To develop an understanding of system-level and memory testing methodologies, including ATPG, core-based testing, verification techniques, and memory-specific fault models.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the VLSI testing process, test equipment, fault models, and the importance of testing in the VLSI design flow.	Understand
CO2	Apply fault simulation techniques and test generation algorithms for combinational and sequential VLSI circuits.	Apply
CO3	Explain Design-for-Testability (DFT) approaches including scan architectures, BIST, and analog test strategies.	Understand
CO4	Explain system-level test strategies and verification techniques using simulation, formal methods, and hardware emulation.	Understand
CO5	Explain specialized test techniques for memory devices, including RAM and ROM testing, using pattern-sensitive and technology-specific fault models.	Understand

COURSE CONTENTS

Unit I	**Introduction to Testing**	**(07 hrs)**	**COs Mapped - CO1**

Introduction to the concepts and techniques of VLSI (Very Large Scale Integration) design verification and testing,VLSI testing process and test equipment, test economics and product quality, fault modeling, testing and verification in VLSI design process.

Unit II	**Memory Test**	**(07 hrs)**	**COs Mapped - CO2**

Functional RAM Testing with March Tests, Testing RAM Neighborhood Pattern-Sensitive Faults, Testing RAM Technology and Layout-Related Faults, RAM Test Hierarchy, Cache RAM Chip Testing , Functional ROM Chip Testing

Unit III	**Design for Testability**	**(08 hrs)**	**COs Mapped – CO3**

Design for testability, Scan and Boundary scan architectures, Built-in Self-test (BIST) and current-based testing, analog test bus standard.			
Unit IV	**System-Level Testing and Design Verification Techniques**	**(07 hrs)**	**COs Mapped – CO4**
System test and core-based design, ATPG, Embedded core test fundamentals. Design verification techniques based on simulation, analytical and formal approaches. Functional verification. Timing verification. Formal verification. Basics of equivalence checking and model checking. Hardware emulation.			
Unit V	**VLSI Test Methods and Fault Simulation Techniques**	**(07 hrs)**	**COs Mapped – CO5**
Test methods, logic and fault simulation, modeling circuits for simulation, algorithms for true value simulation, algorithms for fault simulation, statistical methods for fault simulation, testability measures , combinational circuit test generation, sequential circuit test generation.			

Text Books

1. Bushnell M L, Agrawal V D, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.

Reference Books

1. Abramovici M, Breuer M A and FriedmanA D, "Digital systems and Testable Design", JaicoPublications.
2. Crouch A L, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall
3. Kropf T, "Introduction to Formal Hardware Verification," Springer Publications.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

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B. E. B. Tech. Pattern 2022 Semester: VII **ETC224006C: Climate Change and Green Energy**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02 hrs/week	**02**	**InSem Exam: 20 Marks** **EndSem Exam: 30 Marks**
Prerequisite Courses, if any: Environmental Studies & Sustainability		
Course Objectives: 1. To raise awareness among students about the scenario of climate change. 2. Understand the role of international climate negotiations. 3. Understand the need for large and immediate cuts in greenhouse gas emissions 4. Explain the basic principles of the atmospheric greenhouse effect and the term 'Net Zero'.		

Course Outcomes: On completion of the course, students will be able to –		
	Course Outcomes	**Bloom's Level**
CO1	**Explain the basic concepts of Climate Change**	2-Understand
CO2	Describe environmental and climate issues and evaluate their impact on climate change, adaptation, mitigation, and sustainability goals.	2-Understand
CO3	Elaborate the role of international climate negotiations	2-Understand
CO4	Describe the Fundamentals of Green Energy	2-Understand
CO5	Explain the role of renewable energy technologies in achieving net-zero emissions.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Climate Change**	**(06 hrs)**	**COs Mapped - CO1**
Introduction to climate change, Climate change due to Natural and anthropogenic impact, Past climatic changes: Snowball Earth, Icehouses and Greenhouses, Green House Effects, Green house gases and their GWP(Global Warming Potentials) Impacts of climate change.			
Unit II	**Climate Science and Environmental Issues**	**(06 hrs)**	**COs Mapped - CO2**
Climate Science, Environmental and Climate Issues: Effects of global warming, acid rain, ozone layer depletion on climate changes. Climate change: vulnerability and adaptation, Mitigation and Adaptation Strategies.			
Unit III	**Climate change and International agreements**	**(06 hrs)**	**COs Mapped – CO3**

COP 21 Paris Agreement, The United Nations Framework Convention on Climate Change (UNFCCC), The Intergovernmental Panel on climate change (IPCC), The Clean Development Mechanism (CDM), Reduced Emissions from Deforestation and Degradation (REDD). Conservation of natural carbon sinks. National inventory management system in India (NIMS), The Kyoto Protocol, COP (Conference of the parties)

Unit IV	**Green Energy**	**(06 hrs)**	**COs Mapped – CO4**

Introduction to Green Energy, World energy usage, Energy reserves - Energy cycle of the earth- Environmental aspects of energy utilization-renewable energy resources, Overview of Renewable Energy Sources: Solar Energy, Geo thermal Energy, Wind and Tidal Energy, Biomass Energy, Hydro electric Energy.

Unit V	**Green Energy Applications for Net-Zero Emissions and Carbon Neutrality**	**(06 hrs)**	**COs Mapped – CO5**

Introduction to Net Zero Emissions and Carbon Neutrality, Green Energy Technologies for Carbon Reduction, Sustainable Practices for Carbon Neutrality, Future of Green Energy and Net Zero, Concept of Carbon market/ Carbon Credit.

Text Books

1. **"Climate Change: A Very Short Introduction"** by Mark Maslin (Oxford University Press, 2014)
2. **"Climate Change: The Science of Global Warming and Our Energy Future"** by EdmondA. Mathez (Oxford University Press, 2011**)**
3. **"Climate Change: Law and Policy"** by **Alexander Zahar**and **Yannick Radi** (Edward Elgar Publishing, 2019)
4. **"Renewable Energy: Power for a Sustainable Future"** by **Godfrey Boyle** (Oxford University Press, 2012)
5. **"Carbon Neutrality: The Ultimate Guide to Achieving Net Zero Carbon Emissions"** by**Michael C m.Nash**(2020)

Reference Books

1. **"The Climate Crisis: An Introductory Guide to Climate Change"** by David Archer and Stefan Rahmstorf (Cambridge University Press, 2010).
2. **"Climate Change: Impacts, Adaptation, and Vulnerability"** by Intergovernmental Panel on Climate Change (IPCC) (Cambridge University Press, 2014)
3. **"The Climate Crisis: An Introductory Guide to Climate Change"** by David Archer and Stefan Rahmstorf (Cambridge University Press, 2010)
4. **"The Energy Transition: The Global Race to Net Zero"**by **Michael Bradshaw**(2022)
5. "Paleoclimatology: From Snowball Earth to the Anthropocene" by Colin P. Summerhayes (2020)

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	-	-	-	3	-	-	-	-	3	-	-	-
CO2	2	-	-	-	-	3	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	3	3	-	3	-	-	-	-	-
CO4	3	-	-	-	-	3	-	-	-	-	3	-	-	-
CO5	2	-	-	-	-	3	-	-	-	-	3	-	-	-

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B. E. B. Tech. Pattern 2022 Semester: VII

ETC224006D: Drives and Control

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :02hrs/week	02	InSem Exam: 20 Marks EndSem Exam: 30 Marks

Prerequisite Courses, if any:

Course Objectives:

1. Understand the basics, types, and selection factors of electric drives.
2. Learn motor characteristics and braking methods.
3. Study starting techniques and control circuits for motors.
4. Explore conventional and solid-state speed control of DC drives.
5. Understand speed control techniques for AC drives and their applications.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Identify basic elements, types, and selection criteria for electric drives.	1-Remember, 2-Understand
CO2	Analyze speed-torque characteristics and braking of various motors.	4-Analyze
CO3	Elaborate starting methods and control circuits for DC and AC motors.	2-Understand
CO4	Apply speed control methods for DC motors using conventional and solid-state techniques.	3-Apply
CO5	Implement AC motor speed control using voltage control, V/f control, and solid-state devices.	3-Apply, 4-Analyze

COURSE CONTENTS

Unit I	**Introduction to Electrical Drives**	**(06hrs)**	**COs Mapped - CO1**

Basic elements, types of electric drives, factors influencing electric drives, heating and cooling curves loading conditions and classes of duty, Selection of power rating for drive motors with regard to thermal overloading and load variation factors

Unit II	**Drive motor characteristics**	**(06hrs)**	**COs Mapped - CO2**

Mechanical characteristics, speed- torque characteristics of various types of load and drive motors, braking of electrical motors, dc motors: shunt, series, compound motors, single phase and three phase induction motors.

Unit III	**Starting methods**	**(06hrs)**	**COs Mapped –CO3**

Types of dc motor starters, typical control circuits for shunt and series motors, three phase squirrel and slip ring induction motors

Unit IV	Conventional and solid state speed control of D.C Drives	(06hrs)	COs Mapped –CO4
Speed control of DC series and shunt motors, Armature and field control, ward-leonard control system using controlled rectifiers and DC choppers, applications of DC drives.			
Unit V	**Conventional and solid state speed control of AC drives**	**(06hrs)**	**COs Mapped –CO5**
Speed control of three phase induction motor, Voltage control, voltage/frequency control, slip power recovery scheme using inverters and AC voltage regulators, applications of Induction motor.			

Text Books

1. VEDAM SUBRAMANIAM "Electric drives (concepts and applications)", Tata McGraw-Hill.2001
2. NAGARATH.I.J & KOTHARI .D.P,"Electrical machines", Tata McGraw-Hill.1998

Reference Books

1. PILLAI.S.K "A first course on Electric drives", Wiley Eastern Limited, 1998
2. M.D. SINGH, K.B.KHANCHANDANI,"Power electronics," Tata McGraw-Hill.1998
3. H.Partab,"Art and science and utilization of electrical energy,"Dhanpat Rai and sons, 1994

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		-	-	-	-	-	-	-	-	-	2	2
CO2	3	3		2	-	-	-	-	-	-	-	-	3	2
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	3

K. K. Wagh Institute of Engineering Education and Research, Nashik
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Final Year of B. Tech. E&TC Pattern 2022

ETC224007: Research Methodology

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any:
1. Fundamentals of Statistics or Applied Statistics. 2. Introduction to Research or Academic Writing

Companion course, if any:
1. Data Analysis and Interpretation
2. Academic Writing and Publication Ethics

Course Objectives:
1. Understand the fundamental concepts and processes of research.
2. Classify various types of research and research designs.
3. Explore sampling techniques and methods of data collection and analysis.
4. Learn the structure and components of research reports and academic writing.
5. Recognize ethical issues and good practices in research activities.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define and explain key concepts, types, and processes of research.	1- Remember, 2- Understand
CO2	Identify and categorize appropriate research designs for different research problems.	3- Apply
CO3	Analyze collected data using statistical tools and present it effectively.	4-Analyze
CO4	Construct well-structured research reports and academic articles.	6-Create
CO5	Evaluate ethical practices in research and avoid plagiarism.	5- Evaluate

COURSE CONTENTS

Unit I	**Introduction to Research**	**(07hrs)**	**COs Mapped CO1**

The concept of research, characteristics of good research, Application of Research, Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research, Meaning and types of Research hypothesis, Importance of Review of Literature, Organizing the Review of Literature

Unit II	**Types of Research and Research Design**	**(07hrs)**	**COs Mapped – CO2**

Types of Research: Types of research, pure (basic, fundamental) and applied research, qualitative and quantitative. Research Design: Meaning, need, types of research design – Exploratory, Descriptive, Casual research Design, Components of research design, and

Features of good Research design. Experiments, surveys and case study Research design.			
Unit III	**Sampling, Data Collection and analysis**	**(08hrs)**	**COs Mapped - CO3**
Types and sources of data – Primary and secondary, Methods of collecting data, Concept of sampling and sampling methods – sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling, classification and tabulation of data, graphical representation of data, graphs and charts – Histograms, frequency polygon and frequency curves, bell shaped curve and its properties. Statistical Methods for Data Analysis : Applications of Statistics in Research, measures of central tendency and dispersion			
Unit IV	**Research Report**	**(07hrs)**	**COs Mapped - CO4**
Research report: Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations. Components of thesis and dissertations. Referencing styles and bibliography.			
Unit V	**Ethics in Research**	**(07hrs)**	**COs Mapped - CO5**
Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher.			

Text Books

1. Business Research Methods, 9th edition, Tata McGraw Hill, by Donald Cooper and PS Schindler (2009)
2. Research Methodology by Kothari C. R
3. Research Methods for Business, 4th edition, Wiley by Uma Sekaran (2010)

Reference Books

1. Research Methodology, 2nd edition, Pearson Education by Ranjit Kumar (2009)
2. Marketing Research, 5th edition, Pearson Prentice Hall by Naresh Malhotra and S Dash (2009)
3. Research Methodology by Michael V. P

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	2	-	-	-	-	-	2	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	3	3	2	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	3	3	-	2	-	-
CO5	2	2	-	-	-	2	3	3	-	3	-	2	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	**Assignment:** Assignment No. 1 - Unit 1 (10 Marks) Assignment No. 2 - Unit 2 (10 Marks) Assignment No. 3 – Unit 3 (10 Marks) Assignment No. 4 - Unit 4 (10 Marks) Assignment No. 5 - Unit 5 (10 Marks)	**10**
2	**Quiz (Using LMS):** Unit No. 1 (10 Questions - 10 Marks) Unit No. 2 (10 Questions - 10 Marks) Unit No. 3 (10 Questions - 10 Marks) Unit No. 4 (10 Questions - 10 Marks) Unit No. 5 (10 Questions - 10 Marks)	**10**

K. K. Wagh Institute of Engineering Education and Research, Nashik
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Final Year B. Tech. Pattern 2022 Semester: VI **ETC224008: Innovation & Entrepreneurship**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: Industrial & Project Management, Mini Project & Seminar, Project Stage – I, II

Course Objectives:

1. To know innovation and entrepreneurship.
2. To understand design thinking & idea generation process
3. To know legal framework needed for registration of start-up.
4. To know how to prepare business strategy.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain Innovation, Entrepreneurship and characteristics of an entrepreneur.	2-Understand
CO2	Explain design thinking concept & idea generation process	2-Understand
CO3	Explain legal framework needed for registration of start-up.	2-Understand
CO4	Prepare a business plan & develop business strategy	3-Apply

COURSE CONTENTS

Unit I	**Introduction to Innovation and Entrepreneurship**	**(06hrs)**	**COs Mapped CO1**

Role of innovation and entrepreneurship, what it takes to be an entrepreneur, Business fundamentals, Leadership & team building, relation between innovation and entrepreneurship.

Unit II	**Design Thinking & Idea Generation**	**(08hrs)**	**COs Mapped – CO2**

Introduction to Design Thinking, Design Research Strategies, Design Research - tools for observation and immersion, Visualizing ideas, Communicating ideas.
The seed of innovation, Innovation domains, Innovation sustainable conditions, Design factors, Types of innovations and their market impact.

Unit III	**Creating a Startup**	**(05hrs)**	**COs Mapped – CO3**

Types of companies, legal processes for registering companies, registering as startup

Unit IV	**Becoming an Entrepreneur**	**(05hrs)**	**COs Mapped – CO4**

Creating a business plan, Preparing a Pitching presentation, Building business strategy
Text Books
1. Badhai, B, "Entrepreneurship for Engineers", Dhanpat Rai & Co. (p) Ltd. 2. "The Field Guide to Human-Centered Design", by IDEO.org
Reference Books
1. Eric Ries, "The Lean Startup", Penguin Books Limited **(E-Book).**

E-MATERIAL

Sr. No	Title
1	NPTEL Course on "Entrepreneurship" by Prof. C. Bhaktvatsala Rao, IIT Madras Link of the Course: https://onlinecourses.nptel.ac.in/noc21_mg70/preview
2	NPTEL Course on "Design Thinking-A Primer" by Prof. A. Mahalingam, Prof. B. Ramadurai IIT Madras Link of the Course: https://onlinecourses.nptel.ac.in/noc22_mg32/preview
3	NPTEL Course on "Patent Law for Scientists and Engineers" by Prof. Feroz Ali IIT Madras Link of the Course: https://onlinecourses.nptel.ac.in/noc20_hs55/preview
4	NPTEL Course on " Innovation, Business Models and Entrepreneurship" by Prof. Rajat Agarwal, Prof. Vinay Sharma IIT Roorkee Link of the Course: https://nptel.ac.in/courses/110107094

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	-	-	-	-	3	3	3	3	3	3	3
CO2	3	-	-	-	-	3	3	3	3	3	3	3
CO3	3	-	-	-	-	3	3	3	3	3	3	3
CO4	3	-	-	-	-	3	3	3	3	3	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments	30
2	Seminar	20

Expt. No.	Title of Experiment
1	To design a strategy by writing steps to market the project you are building.
2	To generate an idea having novelty.
3	To prepare a business plan.
4	To create a pitching deck.
5	To prepare a business strategy.

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Final Year B. Tech Syllabus 2022 Course

Project Phase 2

Project Phase 1 (2302320)-Credits: 01
Teaching Scheme: Practical 2 Hrs/week
Examination Scheme: TW: 50Marks

Project Phase 2(ETC224009): Credits: 04
Teaching Scheme: Practical 8 Hrs/week
Examination Scheme: OR: 50Marks,
TW: 100 Marks

Prerequisites for the course: Based on knowledge of all subjects

Learning objective for CO1 **Students will be able to:**	
1	Identify specification of the problem.
2	Structure the problem.
3	Identify the appropriate methodology to solve the problem.
4	Define the methodology to solve the problem.
Learning objective for CO2 **Students will be able to:**	
1	Adapt the vital skills of compromise and collaboration.
2	Construct , analyzes and approach problem solution as a team
3	Fully understand the role of each individual in a group to accomplish the goal.
4	Develop leadership skills by aligning with the objective of the project and lead the team towards its goal.
Learning objective for CO3 **Students will be able to**	
1	Plan, co-ordinate and control the complex and diverse activities in project
2	Predict any problems and find solution for it
3	Plan the progress to result in total completion of the project.
Learning objective for CO4 **Students will be able to**	
1	Design appropriately using a modular construction approach to solve the problem as per specifications.
2	Implement the selected methodology to solve the problem.
3	Select the correct hardware according to specifications.
4	Select the correct software for simulation and programming.
5	Validate the result and draw conclusion.
Learning objective for CO5 **Students will be able to**	
1	Present the work done by proper documentation
2	Present paper in national / international conferences, project exhibitions & competitions
Learning objective for CO6 **Students will**	

1	Develop professional practice.
2	Recognize how *to do the project to its best.*
3	Develop ethical Practices.

Course Outcome	**After successful completion of course students will be able to**
CO1	Define, analyze and solve complex real life problem.
CO2	Work in collaborative team as a member or leader.
CO3	Apply project management techniques.
CO4	Identify and apply appropriate tools.
CO5	Communicate effectively in verbal and written form.
CO6	Imbibe ethical practices.

Course context, Relevance, Practical Significance:

Course Content: (Syllabus)

1. **Group Size** The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.

2. **Selection and approval of topic**:

• Topic should be related to real life application in the field of Electronics and Telecommunication OR Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing OR The investigation of practical problem in manufacture and / or testing of electronics or communication equipment OR The Microprocessor / Microcontroller based applications project ispreferable. OR Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted. OR Interdisciplinary projects should be encouraged.

• Each project group interacts and discusses their project idea with Head of Department, Academic coordinator and Project Coordinator. (Project Monitoring committee)

• Students are asked to submit the synopsis on more than one topic according to their area of interest to project coordinator

• Students give presentation to Project Monitoring committee on Topics they have submitted the synopsis.

• These synopses are discussed among the committee of project guides (Project Committee)

- After the presentation committee members select one project topic for each group
- Project guides are allocated according to area of project
- There is also an external guide from industry for industry sponsored projects
- The scope of project is finalized after discussion with the guide
- Each group presents "project introductory seminar" to project guide and Project Monitoring committee members.

3. The examination is conducted by two examiners (internal and external) appointed by the university. The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
4. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.
5. A log book/Project book of Work carried out during the semester will be maintained with monthly review remarks by the guide and HoD. It should have entries related to the work done,problems faced, solution evolved etc., duly signed by internal and external guides.
6. Project report must be submitted in the prescribed format only
7. Project Seminarassessment is based on the project topic. It consists of Literature Survey and basic project work during 7^{th} semester
8. The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 30pages.
9. Project Work assessment is based Hardware and /or software designed and prototyping of the problem statement
10. The report consists of the Literature Survey, basic project work, Hardware and software design , Testing and conclusion and the size of the report should be maximum of 50pages during 8^{th} semester
11. A certified copy of both the reports is required to be presented to external examiner at the time of final examination.

Relevance of the projects and their contribution towards attainments of POs and PSOs:

- Projects done by final year students are classified into application (for societal, educational, interdisciplinary), product and research type
- Modern tools and technology are used by the students for implementation of their projects
- Each project is evaluated according to rubrics designed
- Each project topic has contribution towards attainment of most of the POs and PSOs
-

Strength of CO-PO/PSO Mapping (Sample): Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped

- Each Course Outcome addresses a sub-set of POs and PSOs to varying levels (strengths: 1- Low, 2 – Medium, 3 - Strong).

	Strength of CO-PO/PSO Mapping													
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	*	*	-	-	-	-	-	*	*
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	3	3	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO6	-	-	-	-	-	-	-	3	-	-	-	-	-	-

Semester VIII

K. K. Wagh Institute of Engineering Education and Research, Nashik
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Final Year B. Tech. Pattern 2022 Semester: VIII

ETC224011: Network Security

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	03	EndSem Exam:60 Marks Continuous Comprehensive Evaluation: 40 Marks

Prerequisite Courses, if any: Computer networks

Course Objectives:

1. To provide a detailed exposure to the field of network security to the students.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Explain the fundamentals of cryptography and different Types of Attacks on Networks.	2-Understand
CO2	Explain the Principles of Cryptography.	2-Understand
CO3	Elaborate the concepts of Authentication and Secure Communication.	2-Understand
CO4	Explain Wireless Network Security and Defensive Mechanisms.	2-Understand
CO5	Explore Security in Emerging and Advanced Computing Paradigms like Cloud and IoT.	2-Understand

COURSE CONTENTS

Unit I	**Basics of Communication Networks and cryptography**	**(06 hrs)**	**COs Mapped - CO1**
Review of Basics of Communication Networks, Different Types of Attacks on Networks, Mathematical Background for Cryptography			
Unit II	**Principles of Cryptography**	**(06 hrs)**	**COs Mapped - CO2**
Principles of Cryptography: Symmetric Key Cryptography and Public Key Cryptography, Message Integrity, Cryptographic Hash Functions, and Digital Signatures			
Unit III	**Authentication and Secure Communication**	**(07 hrs)**	**COs Mapped – CO3**
Authentication, Public Key Infrastructure, Certificates, Transport-Layer Security,			

Network-Layer Security and Virtual Private Networks			
Unit IV	**Wireless Network Security and Defensive Mechanisms**	**(06 hrs)**	**COs Mapped – CO4**
Security in Wireless Local Area Networks, Wireless Cellular Network Security, Firewalls and Intrusion Detection Systems, Cryptocurrencies and Blockchain			
Unit V	**Cloud, IoT, and Post-Quantum Security Mechanisms**	**(06 hrs)**	**COs Mapped – CO5**
Cloud Security, Security of the Internet of Things (IoT), Hardware Security, Anonymous Connections and Onion Routing, Post-Quantum Cryptography			

Text Books

1. C. Kaufman, R. Perlman, M. Speciner, R. Perlner,"Network Security: Private Communication in a Public World",Pearson Education, 3rd edition, 2024
2. W. Stallings, "Cryptography and Network Security:Principles and Practice", Pearson Education, 8th edition, 2023
3. J. Kurose, K. Ross, "Computer Networking: A Top Down Approach", 8th Edition, Pearson Education, 2022

Reference Books

1. B.L. Menezes, R. Kumar, "Cryptography, Network Security, and Cyber Laws", Cengage Learning India Pvt. Ltd.,2018

2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004

3. W. Stallings, "Cryptography and Network Security:Principles and Practice", Pearson Education, 8th edition, 2023

3. L. Peterson, B. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2021

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	3	-	-

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Final Year. B. Tech. Pattern 2022 Semester: VIII **ETC: Biomedical Signal Processing (Elective - VI)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**EndSem Exam:60 Marks** **Continuous Comprehensive Evaluation: 40 Marks**

Prerequisite Courses, if any: Digital Signal Processing

Companion course, if any: ----

Course Objectives:

1. The course aims to introduce the origin and nature of biomedical signals like ECG, EEG, and EMG.
2. It covers techniques for artifact removal, event detection, and waveform analysis in time and frequency domains.
3. Students will learn to extract meaningful features and apply system modeling methods such as AR and ARMA.
4. The course emphasizes practical skills through case studies and tutorials using modern signal processing tools.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain the fundamentals and origin of biomedical signals, and basic preprocessing techniques	2
CO2	Apply advanced filtering techniques for artifact removal in biomedical signals	3
CO3	Analyze significant events in biomedical signals	4
CO4	Extract meaningful features from biomedical signals in time and frequency domains	4
CO5	Model biomedical systems and design signal processing algorithms	2

COURSE CONTENTS

Unit I	**Introduction to Biomedical Signals and Preprocessing**	**(08 hrs)**	**COs Mapped CO1**

Preliminaries Biomedical signal origin & dynamics (ECG), Biomedical signal origin & dynamics (EEG, EMG, etc.)Filtering for removal of artefacts Statistical preliminaries Time domain filtering: Synchronized Averaging, Moving Average Time domain filtering: Moving Average Filter to Integration, Derivative-based operator, Frequency domain filtering: Notch Filter, Optimal Filtering: The Weiner Filter.

Unit II	**Advanced Filtering Techniques**	**(08 hrs)**	**COs Mapped – CO1**

Filtering for Removal of Artefacts, Optimal Filtering: The Weiner Filter ,Adaptive Filtering

Selecting Appropriate Filter

Unit III	**Event Detection and Waveform Analysis**	**(08 hrs)**	**COs Mapped – CO2**

Event Detection:

Example events (P, QRS and T wave in ECG), Derivative based Approaches for QRS Detection, Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection, Correlation Analysis of EEG Signal,Waveform Analysis: Case studies, Morphological Analysis of ECG,Correlation coefficient, The Minimum phase correspondent.

Unit IV	**Signal Feature Extraction and Frequency Domain Analysis**	**(08 hrs)**	**COs Mapped – CO2**

Signal feature extraction: Signal length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor

Frequency-domain Analysis: Period gram

Averaged Periodogram,Blackman-Tukey Spectral Estimator,Daniell's Spectral Estimator, Measures derived from PSD

Unit V	**Modeling of Biomedical Systems**	**(08 hrs)**	**COs Mapped – CO3**

Modeling of Biomedical Systems:
Motor unit firing pattern, Cardiac rhythm
Formants and pitch of speech, Point process
Parametric. System modelling, Autoregressive model
Autocorrelation method, Application to random signals, Computation of model parameters,Levinson-Durbin algorithm
Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection
Relation between AR and Cepstral coefficients.
Modelling of Biomedical Systems
ARMA model
Sequential estimation of poles and zeros
Tutorials:
Tutorial 1: Notch filter design
Tutorial 1: Synchronized averaging
Tutorial 1: Design Butterworth low pass filter

Text Books

1. "Biomedical Signal Processing and Signal Modeling", Author: Eugene N. Bruce, Publisher: Wiley-Interscience

2. R. Rangayan, “Biomedical Signal Analysis”, Wiley

3."Biomedical Signal Processing: Principles and Techniques", Authors: D.C. Reddy, Publisher: McGraw-Hill

Reference Books

1**"Signals and Systems for Bioengineers",Author:** John Semmlow,**Publisher:** Academic Press

2. **"Biosignal and Medical Image Processing",Author:** John L. Semmlow,**Publisher:** CRC Press

3.**"Practical Guide for Biomedical Signals Analysis Using Machine Learning Techniques",Editors:** Varun Bajaj, G. R. Sinha, C. H. Liu,**ublisher:** Academic Press

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	2	-	-	-	1	1	-	2	2	3
CO2	3	3	2	3	3	-	-	-	1	1	-	2	2	3
CO3	3	3	2	3	3	-	-	-	2	1	1	2	2	3
CO4	3	3	3	3	3	-	-	-	2	2	1	3	2	3
CO5	3	3	3	3	3	1	-	1	2	2	2	3	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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Final Year B. Tech. Pattern 2022 Semester: VIII **ETC224012: Mixed Signal Design**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**EndSem Exam:60 Marks** **Continuous Comprehensive Evaluation: 40 Marks**

Prerequisite Courses, if any: Analog VLSI Circuit Design, Digital VLSI Circuit Design

Companion course, if any: -

Course Objectives:

1. To know mixed signal circuits like DAC, ADC, PLL etc.
2. To gain knowledge on filter design in mixed signal mode.
3. To acquire knowledge on design different architectures in mixed signal mode.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Explain sampling circuits, switches, and sample-and-hold architectures.	2
CO2	Explain integrator types, digital filters, and switched-capacitor filter behavior.	2
CO3	Explain DAC characteristics, performance metrics, and design common architectures of DAC.	3
CO4	Explain ADC principles, performance, and Design various converter architectures.	3
CO5	Design comparators, multipliers, and PLL/DLL-based frequency synthesis.	3

COURSE CONTENTS

Unit I	Sampling Circuits	**(06 hrs)**	**COs Mapped CO1**

Fundamentals of analog signal sampling and aliasing, different types of sampling switches. Performance metrics, Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture

Unit II	Analog and Digital Filters	**(07 hrs)**	**COs Mapped – CO1**

Integrator building blocks: active-RC, MOSFET-C, and gm-C, Digital filters: FIR, IIR, Bandpass and highpass sinc filters Switched-capacitor filters: architecture and theory, Non-idealities in switched-capacitor filters;

Unit III	D/A Converter Architectures	**(08 hrs)**	**COs Mapped – CO2**

Ideal DAC characteristics: resolution, linearity, monotonicity, DAC performance metrics:

INL, DNL, settling time, glitch, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures.			
Unit IV	A/D Converter Architectures	**(08 hrs)**	**COs Mapped – CO2**
Ideal ADC characteristics, quantization error and resolution, ADC performance metrics: SNR, ENOB, INL, DNL, SFDR , Flash and SAR ADC architectures, Pipelined ADC, Oversampling converters			
Unit V	Mixed-Signal Blocks – Comparators, PLLs, and Frequency Synthesizers	**(07 hrs)**	**COs Mapped – CO3**
Characterization of a comparator, basic CMOS comparator design, analog multiplier design, simple PLL, charge-pump PLL, Design of PLL's and DLL's and frequency synthesizers.			

Text Books

1. Baker Jacob R, "CMOS Mixed signal Circuit Design," Wiley IEEE Press
2. Baker Jacob R., "CMOS circuit design layout and simulation" Wiley IEEE
3. Razavi, B., "Design of Analog CMOS Integrated Circuits", 1 st Ed., Mc Graw Hill.

Reference Books

1. R. Gregorian, Gabor. C. Temes , "Analog MOS ICs for Signal Processing " , John Wiley & Sons.
2. Baker, Li, Boyce, "CMOS Circuits Design, Layout and Simulation", TMH.
3. Allen Halburg, "Analog Integrated Circuits", Oxford
4. David A. Johns, Ken Martin, John , "Analog Integrated Circuit Design" Wiley & Sons.
5. B.Razavi - Monolithic Phase-locked loops and clock recovery circuits: Theory and design.

Strength of CO-PO Mapping													PO-PSO mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	2
CO2	3	3	2	1	2	-	-	-	-	-	-	-	1	2
CO3	3	2	1	2	2	-	-	-	-	-	-	-	2	2
CO4	3	3	1	2	2	-	-	-	-	-	-	-	2	2
CO5	3	3	2	2	2	-	-	-	-	-	-	-	1	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	**Assignment:** Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	**10**
2	**Quiz (Using Learnico):** Unit No. 1 (10 Questions - 10 Marks) Unit No. 2 (10 Questions - 10 Marks) Unit No. 3 (10 Questions - 10 Marks)	**10**

	Unit No. 4 (10 Questions - 10 Marks) Unit No. 5 (10 Questions - 10 Marks)	

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T. Y. B. Tech. Pattern 2022 Semester: VIII **ETC224012C: Advanced Mobile Communication (Elective VI)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**EndSem Exam:60 Marks** **Continuous Comprehensive Evaluation: 40 Marks**
Prerequisite Courses, if any: Fundamentals of Optical Communication, Cellular Networks, Digital Communications.		
Companion course, if any: ----		
Course Objectives: 1. Understand Optical Wireless Communication Fundamentals 2. Analyze System Design and Performance in Optical Wireless Networks 3. Explore Emerging Technologies and Applications in Optical Wireless Communication		

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the Fundamentals of Optical Wireless Communication (OWC)	2
CO2	Analyze Optical Channel Modeling and Multiple-Source Systems	3
CO3	Compare Indoor and Outdoor Optical Wireless Communication Systems	2
CO4	Investigate Modulation and Signal Processing Techniques in OWC and UWOC	3
CO5	Explore Advanced Optical Wireless Technologies and Applications	3

COURSE CONTENTS

Unit I	**Fundamentals of Optical Wireless Communication**	**(06 hrs)**	**COs Mapped CO1**
Introduction to optical wireless channel (OWC) and modeling, Optical channel modeling, Signal propagation, RMS delay spread, Optical wireless channel (OWC) characteristics, Intensity modulation direct detection, Lambertian radiation, Channel model for single-source case, Channel impulse response			
Unit II	**Optical Wireless Channel Modeling and MIMO Techniques**	**(07 hrs)**	**COs Mapped – CO1**
Channel model for multiple sources, Steps in site-specific channel model approach, Channel model example, MIMO and angle diversity receiver, Optical MIMO system diagram, Imaging diversity optical MIMO, Indoor channel limitations, Outdoor optical wireless channel, Comparison of FSO and RF communication systems, Atmospheric			

losses, scattering, empirical models			
Unit III	**Free-Space Optics and Underwater Optical Wireless Communication**	**(08 hrs)**	**COs Mapped – CO2**
Range equation for FSO links, Near and far field of light emission using beam forming optics, Beam divergence loss, use of beam expander, link design example, atmospheric turbulence, statistical models for received signal irradiance, Effect of atmospheric turbulence on Gaussian beam, Techniques for turbulence mitigation: aperture averaging, spatial diversity, adaptive optics, coding, Hybrid RF/FSO, Underwater optical wireless communication (UWOC) Optical beam propagation in underwater environments, underwater channel modeling, radiative transfer equation, underwater turbulence model			
Unit IV	**Modulation and Signal Processing for Optical Wireless Communication**	**(08 hrs)**	**COs Mapped – CO2**
Noise in UWOC channel, classification of UWOC links, OFDM & Multicarrier modulation, Frequency offset in OFDM, SNR in OFDM, PAPR, Comparison of PAPR reduction techniques. OFDM for VLC: DC optical OFDM (DCO-OFDM), Asymmetrical clipped optical OFDM (ACO-OFDM), Unipolar OFDM (U-OFDM) Color Shift Keying (CSK) modulation, CSK system block diagram, CSK signal space, channel model, probability of error and SER, High-order CSK			
Unit V	**Advanced Multiple Access Techniques and Applications**	**(07 hrs)**	**COs Mapped – CO3**
Non-orthogonal multiple access (NOMA) for 5G and IoT, Classification of multiple access techniques, comparison of NOMA with OMA, Two-user NOMA network, issues with NOMA, NOMA in VLC: block diagram, VLC channel model, indoor NOMA-VLC system example, MIMO receiver design: ZF receiver, MMSE receiver, SNR performance, MIMO-NOMA: uplink/downlink, cooperative NOMA (C-NOMA), Cluster-based MIMO-NOMA, examples of DCO-OFDM-based MIMO PD-NOMA VLC system, LiFi WiFi coexistence, hybrid networks, design considerations, V2V and V2X communication: general network architecture, safety services, VLC-based V2V model			

Text Books

1. Xizheng Ke, Ke Dong, Optical Wireless Communication, Springer, July 2023, ISBN: 978-9811903847.

2. Ezio Biglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, Arogyaswami Paulraj, and H. Vincent Poor, MIMO Wireless Communications, Cambridge University Press, 2007, ISBN: 9780511618420.

3. Yuanwei Liu, Zhijin Qin, Zhiguo Ding, Non-Orthogonal Multiple Access for Massive Connectivity, Springer, 2019, ISBN: 978-3030309749.

Reference Books

1. Z. Ghassemlooy, W. Popoola, S. Rajbhandari, Optical Wireless Communications: System and Channel Modelling with MATLAB, CRC Press, second edition, 2019, ISBN: 9780367199804

2. S. M. Riazul Islam, Nurul Huda Mahmood, Ekram Hossain, Non-Orthogonal Multiple Access for 5G and Beyond, Springer, 2021, ISBN: 9783030554880

Additional resources for study

1. IEEE Papers on 6G, IoT and VLC communications
2. NPTEL course: Optical Wireless Communications for Beyond 5G Networks and IoT, IIIT Delhi, available: https://youtube.com/playlist?list=PLyqSpQzTE6M_yqX6gn0Zmx-C7gv5IAEx5&feature=shared
3. Ethan Png (2025). Visible Light Communication,

(https://www.mathworks.com/matlabcentral/fileexchange/53179-visible-light-communication), MATLAB Central File Exchange.

4. Mohsan, S. A. H., Sadiq, M., Li, Y., Shvetsov, A. V., Shvetsova, S. V., & Shafiq, M. (2023). NOMA-Based VLC Systems: A Comprehensive Review. Sensors, 23(6), 2960. https://doi.org/10.3390/s23062960

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Strength of CO-PO Mapping													**CO-PSO Mapping**	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	3	2	2	-	-	-	-	3	-	2	2
CO2	3	3	2	3	2	2	-	-	-	-	3	-	2	2
CO3	3	3	2	3	2	2	-	-	-	-	3	-	2	2
CO4	3	3	2	3	2	2	-	-	-	-	3	-	2	2
CO5	3	3	2	3	2	2	-	-	-	-	3	-	2	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments (one each on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5)	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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B. E. B. Tech. Pattern 2022 Semester: VIII **ETC224012D: e Mobility and Charging Infrastructure**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week	**02**	**EndSem Exam:60 Marks** **Continuous Comprehensive Evaluation: 40 Marks**

Prerequisite Courses, if any: Electrical Circuits and Machines, Power Electronics, Drives and control

Course Objectives:

1. To introduce students to the fundamentals of battery-driven electric vehicles (EVs).
2. To provide an overview of the key focus areas within the EV domain, including vehicle dynamics, electric motors, power electronics, PWM, and control systems.
3. To develop a strong conceptual understanding of each EV subsystem and how they integrate into the complete vehicle.
4. To enable students to model, simulate, and analyze EV components using MATLAB/Simulink.
5. To prepare students with the foundational skills required for further study or careers in electric vehicle technology and related fields.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the structure and working principles of electric vehicles and analyze vehicle dynamics using simulation tools.	2-Understand
CO2	Explain the operation of DC drives and power electronic converters, and simulate their performance using MATLAB/Simulink.	2-Understand, 3-Apply
CO3	Understand the types, functions, and integration of sensors in electric vehicle systems and simulate their roles in drive control.	3-Apply
CO4	Model and simulate Permanent Magnet Synchronous Motor (PMSM) drives for electric vehicle applications.	3-Apply, 4-Analyze
CO5	Apply vector control strategies to PMSM drives and evaluate their performance through simulation.	3-Apply, 5-Evaluate

COURSE CONTENTS

Unit I	**Introduction to Electric Vehicles and Vehicle Dynamics**	**(07hrs)**	**COs Mapped - CO1**

Overview of Electric Vehicles: Types, components, and advantages, Comparison of EVs with conventional vehicles, Focus areas in EV technology and system architecture, Fundamentals of vehicle dynamics, Mathematical modelling of vehicle motion, Longitudinal and lateral dynamics., Simulation of vehicle dynamics in

MATLAB/Simulink.

Unit II	Fundamentals of Electric Drives and Power Electronics	(07hrs)	COs Mapped - CO2

Introduction to electric drives used in EVs, Basic principles of DC motor operation, Power electronic devices and their characteristics, Converter topologies for DC drives (Buck, Boost, etc.). Modelling and simulation of DC drives in MATLAB/Simulink.

Unit III	Sensors in Electric Vehicles and E-Mobility	(07hrs)	COs Mapped – CO3

Role of sensors in EV performance, safety, and control; classification: position, speed, current, temperature, environmental, and inertial sensors, motor position sensors (Hall, encoders, resolvers); current and voltage sensors in converter feedback loops. Sensor role in V/f control, vector control, SVPWM schemes; feedback for closed-loop control; real-time torque and speed sensing. Voltage, current, and temperature sensors, SOC and SOH estimation, insulation monitoring, pilot/proximity sensors in charging systems.

Unit IV	Permanent Magnet Synchronous Motor (PMSM) Drives	(07hrs)	COs Mapped – CO4

Construction and working of PMSM, Comparison of PMSM with IM and BLDC motors, Dynamic modeling of PMSM drives, Role of position sensors and feedback mechanisms, Implementation of PMSM models in MATLAB/Simulink.

Unit V	Advanced Control of PMSM Drives	(07hrs)	COs Mapped – CO5

Principles of vector control (Field-Oriented Control) for PMSM, Space Vector PWM (SVPWM) for high-performance drives, Simulation of vector control schemes in MATLAB/Simulink., Integration of PMSM control in EV drivetrain systems, Real-time application case studies using MATLAB/Simulink.

Text Books

1. Iqbal Husain, ELECTRIC and HYBRIDVEHICLES, Design Fundamentals, CRC Press,2003.
2. M. Ehsani, Y. Gao, S. Gay and A. Emadi,Modern Electric, Hybrid Electric, and Fuel CellVehicles, CRC Press, 2005.

Reference Books/ Courses

1. EV – Vehicle Dynamics and Electric Motor Drives
2. https://onlinecourses.nptel.ac.in/noc24_ee30/preview
3. https://www.youtube.com/playlist?list=PLp6ek2hDcoNCROoQbG05xNfiBEY7492Vn

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	3	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO3	3	2	3	-	3	-	-	-	-	-	-	-	3	3
CO4	3	2	2	-	3	-	-	-	-	-	-	-	3	3
CO5	3	2	3	-	3	-	-	-	-	-	-	-	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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B. Y. B. Tech.Pattern 2022 Semester: VIII **ETC224013: Financial Literacy**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 50 Marks**
Prerequisite Courses, if any: Basic Finance Knowledge.		
Course Objectives: The purpose of this course is to empower the students with sound financial knowledge and financial management skills for their long-term financial being. The course is designed with the strong belief that financial well-being has a positive correlation with the overall well-being of an individual as well as society.		

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Acquire financial management skills-essential life skills for 21st Century .understand financial planning, management concepts, and basic banking operations in India.	2-Understand
CO2	Understand investment objectives, assess risk profiles, and apply diversification and asset allocation strategies effectively	2-Understand
CO3	Understand investment options, stock markets, and stock selection criteria.	2-Understand
CO4	Understand financial planning concepts and objectives, and gain knowledge of mutual funds and their types.	2-Understand
CO5	Understand key theories of capital structure and dividend decisions, and analyze factors influencing dividend policy.	2-Understand

COURSE CONTENTS

Unit I	**Foundations of Finance**	**(06 hrs)**	**COs Mapped - CO1**
Need for Financial Planning, Financial Goals, Financial Management: Concept, Finance Function. Banking in India: Concepts of Banking, Types of Bank Accounts and Deposits			
Unit II	**Investment Management-I**	**(06 hrs)**	**COs Mapped - CO2**
Investment Goals: Basic Investment Objectives, Time Frame, Assessing Risk Profile, Diversification and Asset Allocation.			
Unit III	**Investment Management-II**	**(06 hrs)**	**COs Mapped – CO3**
Investment and Saving alternatives for a Common Investor: Insurance, Stocks, Bonds, etc. Stock Markets: Primary and Secondary Markets. Criteria for Stock Selection.			
Unit IV	**Financial Planning and Mutual Funds**	**(06 hrs)**	**COs Mapped – CO4**

Financial Planning: Concept and Objectives. Mutual Funds: Concept and History of Mutual Funds in India. Types of Mutual Funds.			
Unit V	**Capital structure of firms**	**(06 hrs)**	**COs Mapped – CO5**
Capital structure of firms-An overview, Net income approach, Net operating income approach, Traditional proposition, MM Proposition. Dividend decisions-An overview, Relevance of dividend, Dividend policy formulation, Dimensions of divined policy, Legal & procedural aspects of dividend decisions			

Text Books

1. Prasanna Chandra "Financial Management: Theory and Practice" 9th Edition, McGraw Hill Education Publishers.
2. Brealey and Myers," Principles of Corporate Finance", 11th Edition, McGraw Hill Education Publishers
3. Khan, M.Y. and Jain, P.K., "Financial Management", 7th Edition, McGraw-Hill Education Publishers.

Reference Books

6. Van Horne, J.C, "Fundamentals of Financial Management", 13th Edition, Prentice Hall Publishers.
7. Pandey I.M., "Financial Management", 11th Edition, Vikas Publishers

Strength of CO-PO Mapping												**CO-PSO Mapping**	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	2	-	2	2	2	3	-	-
CO2	-	3	2	-	2	-	-	2	2	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-	-	-	-
CO4	3	2	2	-	-	-	-	2	-	-	-	-	-	-
CO5	3	3	2	2	3	-	2	-	2	-	-	3	-	-

Guidelines for Continuous Comprehensive Evaluation of Online Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation (Online Course)**	**Marks Allotted**
1	https://onlinecourses.nptel.ac.in/noc24_mg21/preview	

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B.E E&TC Pattern 2023 **ETC223015: On-Job Training**		
Teaching Scheme:	**Credit Scheme**	**Examination Scheme:**
Practical : 24 hr/week	**12**	**TermWork: 200Marks** **Oral : 100 Marks**

Course Objectives:

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the **'Internship'** will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic ,professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

	Course Outcomes	**Bloom's Level**
CO1	Comprehend professional competence through internship.	1
CO2	Apply academic knowledge in a personal and professional environment.	3
CO3	Build the professional network and expose students to future employees.	3
CO4	Apply professional and societal ethics in their day to day life.	3
CO5	Become a responsible professional having social, economic and administrative considerations.	4
CO6	Make own career goals and personal aspirations.	5

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales. Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations. Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as apart of the Final Year Engineering curriculum.

A. Duration:

Internship to be completed before commencement of semester 8 of at least Six months; and it is to be assessed and evaluated in semester 8.

B. Framework of Internship:

- Minimum duration of internship is of six months.
- Internship to be done during 8th semester.
- Students can search for an industry / government organization semi- government organization for an internship.
- Students have to take prior written permission for internship from the HOD (E&TC).
- Leave will not be permitted during the internship period. In case of emergency, take prior permission from HOD (E&TC).
- Students have to maintain internship daily diary & submit to the department after completion of internship.
- Students have to prepare an internship report & submit to the department after completion of internship.
- Students have to prepare an internship and appear for viva to the committee comprising HOD (E&TC), Academic Coordinator, Internal Supervisor.

C. Internship Guidelines:

a) Guidelines to the Institute:

Department will arrange internship for students in industries/organization after seventh semester or as per AICTE/ affiliating University guidelines & managing internships. The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email should go to industry to allot various slots of 27-30 weeks as

internship periods for the students. Students request letter /profile / interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.

Step5: Students will submit training report after completion of internship.

Step6: Training Certificate to be obtained from industry.

Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell.

b) Guidelines to the students:

Any absenteeism by students during their internship should be informed immediately to the mentor/reporting manager and the internal guide. No special considerations will be accepted. Students cannot take leave for college work or fest activities. The leave permission for any college related activities will be solely approved by the HOD. The monthly attendance format should be duly submitted to the internal guide by the intern.

c) Internal reporting Guidelines:

Every intern should send weekly report to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guide on regular basis. Interns should have at least fortnightly verbal communication with the internal guide without fail. In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.

d) Internship Diary/Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should recording the daily training diary account of the observations, impressions, information

gathered and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working. Internship Diary/ workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. Internship Diary / workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries.
- Adequacy &quality of information recorded
- Data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Monitoring & Evaluation of Internship

The industrial training of the students will be evaluated in three stages:

 Evaluation by Industry.

 Evaluation by faculty supervisor on the basis of site visit(s) or periodiccommunication.

 Evaluation through seminar presentation/viva-voce at the Institute (This evaluation can be reflected through marks assigned by Faculty Mentor).

1. Evaluation by Industry

The industry will evaluate the students based on the punctuality, eagerness to learn, maintenance of daily diary and skill test in addition to any remarks. Finally, Industry supervisor will evaluate overall performance of intern on a scale of 1-10 where 1 indicates Unsatisfactory and 10 indicates Excellent Performance and any value in between 1 to 10 holds meaning accordingly.

2. Evaluation by faculty supervisor on the basis of site visit(s) or periodic communication.

TPO/Staff/Faculty Mentor of the institutes should make a surprise visit to the internship site, to check the student's presence physically, if the student is found absent without prior intimation to the concerned Industry, entire training may be cancelled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to availing leave. Students are eligible .To avail 1day or 2 day leave in 6months of the internship period apart from holidays and weekly offs.

3. Evaluation through seminar presentation/viva-voce at the Institute (This evaluation can be reflected through marks assigned by Faculty Mentor)

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute.

The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

Seminar presentation will enable sharing knowledge & experience amongst students&Teacher, and build communication skills and confidence in students

f) Internship Report:

The report shall be presented covering following recommended fields but limited to:

- Title/Cover Page
- Internship completion certificate.
- Internship Place Details- Company background-organization and activities/Scope and object of the study / personal observation.
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results/Analysis /inferences and conclusion
- Suggestions/Recommendations for improvement to industry, if any
- Attendance Record
- List of reference(Library books, magazines and other sources)

g) Feedback from internship supervisor(External and Internal):

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

- ✓ Technical knowledge
- ✓ Discipline
- ✓ Punctuality
- ✓ Commitment
- ✓ Willingness to do the work

- ✓ Communication skill
- ✓ Individual work
- ✓ Teamwork
- ✓ Leadership

Strength of CO-PO Mapping													PO-PSO mapping	
CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	3	2	2	3	2	3	3	-	2	2
CO2	3	3	3	2	2	2	1	3	3	3	3	-	2	3
CO3	2	2	2	2	1	1	3	3	3	2	2	-	1	1
CO4	1	2	1	2	1	3	3	3	2	2	3	-	1	1
CO5	1	2	1	2	1	3	3	2	3	3	3	-	2	2
CO6	2	2	1	1	2	2	2	3	3	3	3	-	2	2