

Marathwada Mitra Mandal's College of Engineering
Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU



Curriculum for
Third Year B. Tech Electronics and
Telecommunication Engineering

A.Y. 2026-27

Permanently Affiliated to SPPU | Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

CONTENTS

Institute Vision and Mission	I
Department Vision and Mission	I
Knowledge and Attitude Profile (WK)	II
Program Outcomes (POs)	III
Program Educational Objectives (PEOs)	IV
Program Specific Outcomes (PSOs)	IV
Abbreviations	V
Curriculum Structure Sem-V & SEM-VI	VI
Semester-V Courses	1
Semester-VI Courses	31

Sr. No.	Description	Page
Semester- V		
ET24PCC301	Analog and Digital Communication Systems	1
ET24PCC302	VLSI Design	3
ET24PCC303	Control Systems	5
ET24PEC304	Elective 1	7
ET24MDM305	Microcontrollers & Embedded Software	16
ET24PCC306	Analog and Digital Communication Systems Lab	18
ET24PCC307	VLSI Design Lab	20
ET24PCC308	Engineering Design and Innovation-1	22
ET24MDM309	Microcontrollers & Embedded Software Lab	24
ET24OEL310	Strategic Management	26
ET24AEC311	Reasoning and Aptitude Development I	28
Semester -VI		
ET24PCC351	Advanced Communication	32
ET24PCC352	Power Electronics and Applications	34
ET24PCC353	Real-Time Operating Systems with QNX	36
ET24PEC354	Elective 2	38
ET24MDM355	Applications of Embedded Systems	46
ET24PCC356	Advanced Communication Lab	48
ET24PCC357	Power Electronics and Applications Lab	50
ET24PCC358	Engineering Design and Innovation- 2	52
ET24OEL359	Leadership & Team Effectiveness	55
ET24VSE360	Internet of Things	57
ET24AEC361	Reasoning and Aptitude Development II	59

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

Our Mission is to:

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

Department Vision

To cultivate globally competent Electronics and Telecommunication Engineers for developing sustainable solutions

Department Mission

Our Mission is to:

M1: To empower students with foundational and emerging technologies in Electronics and Telecommunication Engineering, fostering global competencies

M2: To foster a research and collaborative learning ecosystem that encourages entrepreneurship, holistic and sustainable development

M3: To inculcate ethical values, leadership, adaptability, and a lifelong learnability in a diverse, global engineering

Knowledge and Attitude Profile (WK)

- WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (PO)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Educational Objectives (PEO)

PEO1: Graduates will excel in their professional careers by applying cutting-edge technologies in Electronics and Telecommunication Engineering.

PEO2: Graduates will be globally aware, adaptive, and capable of solving real-world problems through multidisciplinary and innovative thinking.

PEO3: Graduates will evolve into professionals with strong communication, teamwork, leadership, and ethical decision-making capabilities with societal and environmental awareness.

Program Specific Outcomes (PSOs)

Students will be able,

PSO1: Design and develop Embedded systems to provide solutions in the field of Electronics and Telecommunication Engineering.

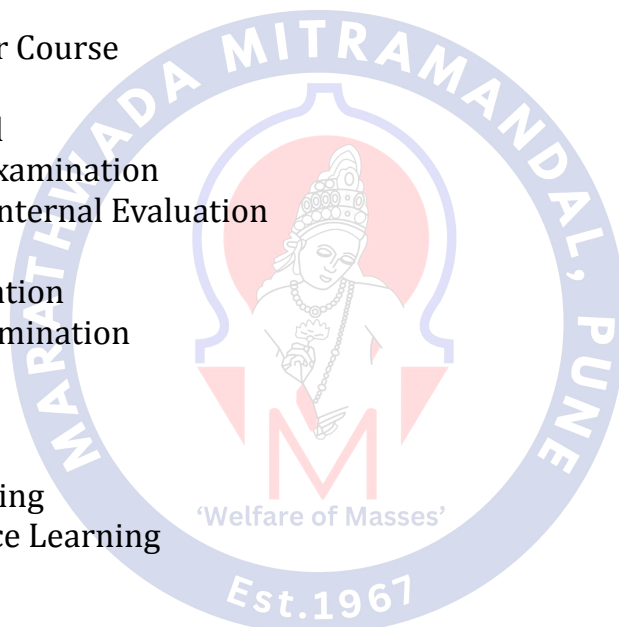
PSO2: Apply and analyze Communication Engineering fundamentals in the field of wireless communications and networking.

PSO3: Apply cutting-edge technology in multidisciplinary fields.



Abbreviations

BSC:	Basic Science Course
UG:	Undergraduate Programme
ESC:	Engineering Science Course
PCC:	Program Core Courses
PEC:	Program Elective Courses
MDM:	Multidisciplinary Minor Courses
OE:	Open Elective
VSC:	Vocational Skill Course
SEC:	Skill Enhancement Course
AEC:	Ability Enhancement Course
IKS:	Indian Knowledge System
VEC:	Value Education Course
FP:	Field Project
CC:	Co-Curricular Course
IT:	Internal Tool
ET:	External Tool
ETE:	End -Term Examination
CIE:	Continuous Internal Evaluation
TW:	Term work
OR:	Oral Examination
PR:	Practical Examination
L:	Lecture
P:	Practical
T:	Tutorial
OL:	Online Teaching
ODL:	Open Distance Learning



Curriculum Structure Sem-V & VI

Third Year B.Tech Electronics and Telecommunication Engineering Semester-V																	
Course Code	Course Name	Course Type	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
			L	P	T	OD L	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
ET24PCC301	Analog and Digital Communication Systems	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PCC302	VLSI Design	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PCC303	Control Systems	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PEC304	Elective 1	PEC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24MDM305	*(Multidisciplinary Minor Theory)	MDM	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PCC306	Analog and Digital Communication Systems Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ET24PCC307	VLSI Design Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ET24PCC308	Engineering Design and Innovation-1	PCC	-	4	-	-	-	-	25	-	-	25	-	2	-	-	2
ET24MDM309	*(Multidisciplinary Minor Lab)	MDM	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
ET24OEL310	*(Open Elective Theory)	OEL	-	-	-	2	-	-	50	-	-	50	-	-	-	2	2
ET24AEC311	Reasoning and Aptitude Development I	AEC	-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Total			15	10	1	2	200	300	125	100	-	725	15	5	1	2	23

*Refer separate Booklet for MDM and OEL

ET24PEC304 Elective 1	
A	Advanced Microcontroller and Applications
B	Digital Signal Processing
C	Database Management System
D	Computer Networks

L- Lecture

ETE- End Term Examination

L : 1 Hr.= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

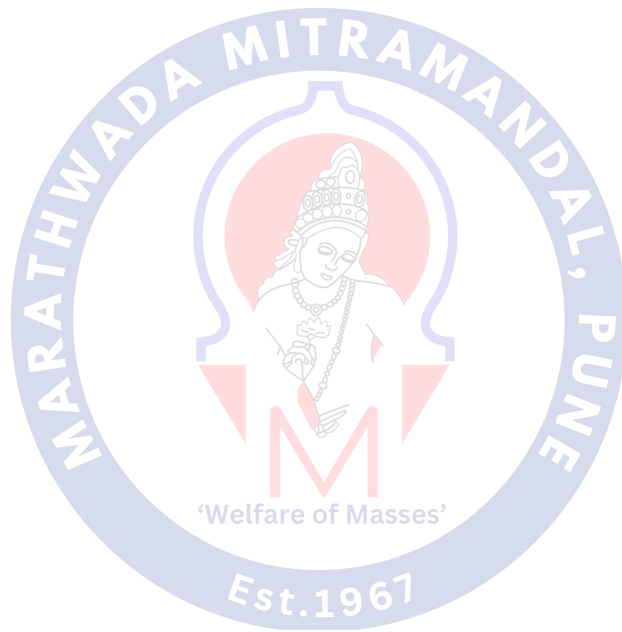
T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral



Third Year B.Tech Electronics and Telecommunication Engineering Semester-VI																	
Course Code	Course Name	Course Type	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
			L	P	T	OD L	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
ET24PCC351	Advanced Communication	PCC	3		-	-	40	60	-		-	100	3		-	-	3
ET24PCC352	Power Electronics and Applications	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PCC353	Real-Time Operating Systems	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PEC354	Elective 2	PEC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24MDM355	*(Multidisciplinary Minor Theory)	MDM	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ET24PCC356	Advanced Communication Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ET24PCC357	Power Electronics and Applications Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ET24PCC358	Engineering Design and Innovation- 2	PCC	-	2	-	-	-	-	25	-	-	25	-	1	-	-	1
ET24OEL359	*(Open Elective Theory)	OEL	-	-	-	2	-	-	50	-	-	50	-	-	-	2	2
ET24VSE360	Internet of Things	VSE	-	4	-	-	-	-	50	-	-	50	-	2	-	-	2
ET24AEC361	Reasoning and Aptitude Development II	AEC	-	-	-	1	-	-	25	-	-	25	-	-	-	1	1
Total			15	10	-	3	200	300	150	100	-	750	15	5	-	3	23

ET24PEC354 Elective 2	
A	Industrial Automation
B	Computer Vision
C	CMOS Digital VLSI Design
D	Electromagnetics and Wave Propagation

* Refer separate Booklet for MDM and OEL

L- Lecture

ETE- End Term Examination

L : 1 Hr.= 1 credit

P- Practical

TW- Term work

P: 2 Hr. = 1 Credit

T- Tutorial

PR- Practical

T: 1 Hr. = 1 Credit

CIE-Continuous Internal Evaluation

OR- Oral



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC301					Course Name: Analog and Digital Communication Systems									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Basic of Electronics Technology, Signals and Systems														
Course Objectives: • To introduce the basic concepts of a communication system along with its performance parameters. • To make the students familiar with Amplitude modulation and demodulation. • To familiarize students with Frequency modulation and demodulation. • To acquaint the students with sampling and various analog to digital conversion techniques. • To familiarize the students with the foundation of the digital communication system. Course Outcomes: After completing the course, the students will be able to: CO1: Articulate the performance parameters of Analog and Digital Communication system. CO2: Recognize the modulation and demodulation techniques for Amplitude Modulation. CO3: Illustrate the modulation and demodulation techniques for Frequency Modulation. CO4: Interpret the importance of Sampling Theorem and analog to digital conversion. CO5: Illustrate the digital representation techniques.														
Unit	Contents													Hrs.
1	Basics of Communication Systems: Analog and digital messages, signal bandwidth & power, signal distortion over a communication channel. Introduction to noise, Signal-to-Noise Ratio and capacity. Concept of baseband and passband signals, signal transmission through Linear Time-Invariant system. Energy Spectral Density, Power Spectral Density, input and output Power Spectral Density.													8
2	Amplitude Modulation & Demodulation: Analog modulation, Double SideBand and Single SideBand modulation, Amplitude demodulation, Vestigial SideBand modulation, Local carrier synchronization, Single SideBand-Suppressed Carrier modulation, performance parameters of Amplitude modulation Self Learning - Amplitude modulated broadcasting system													8
3	Angle Modulation & Demodulation: Angle Modulation, Bandwidth of Angle-modulated waves, Generating Frequency modulated waves, Demodulation of Frequency modulated signals, Superheterodyne receiver, Performance parameters of Frequency modulation, power and bandwidth of Frequency modulated signal, Commercial applications like television transmission Self Learning: Frequency modulated broadcasting system													8
4	Sampling and Analog to Digital Conversion: Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, quantization, Pulse Code Modulation, Companding, Differential Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation.													8
5	Digital Data Transmission:													7

Components of digital communication system, Line coding, Digital Multiplexing, Digital Carrier Systems, T1 carrier system, Synchronization, Scrambler and Descramblers, Intersymbol Interference	
Total Hours	39
Text Books	
1. Dennis Roddy and John Coolen. <i>Electronic Communication</i>, 4th ed., Pearson Education, 2009. 2. B. P. Lathi and Zhi Ding, <i>Digital and Analog Communication System</i>, 4th ed., Oxford University Press, 2010. 3. A. B. Carlson and Paul B. Crilly, <i>Communication Systems</i>, 5th ed., Tata McGrawHill, 2010. 4. Shanmugam K.S, <i>Digital & Analog Communication Systems</i> John Wiley & Sons, NewYork, Jan 2012.	
Reference Book	
1. Simon Haykin, <i>Introduction To Analog & Digital Communications</i>, 2nd ed., Wiley India Pvt. Ltd., 2008. 2. Wayne Tomasi, <i>Advanced Electronic Communications Systems</i>, 6th ed., Pearson Education Limited, 2014.	
Online References	
1. Aditya K. Jagannatham. <i>Principles of Communication Systems</i>. NPTEL, https://nptel.ac.in/courses/108/104/108104091/	



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC302					Course Name: VLSI Design									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Fundamentals of Digital Electronics, Basic Electronic Devices and Circuits														
Course Objectives:														
- To explain the basic concepts of VLSI Design - To explain CMOS Digital Logic Circuits using VLSI technologies - To apply the various Verilog modeling styles in writing the design and testbench codes														
Course Outcomes:														
After completing the course, the students will be able to:														
CO1: Explain the concepts of VLSI design flow and digital design issues														
CO2: Explain the concepts of digital CMOS design														
CO3: Explain the concepts of verilog Hardware Description Language														
CO4: Analyze digital design using Verilog Hardware Description Language														
CO5: Analyze the FPGA architecture for digital logic synthesis														
Unit	Contents													Hrs
1	Introduction to VLSI Design Basics of VLSI Design ,Basics of Digital CMOS Design,IC Fabrication process, CMOS Inverter, VLSI Design flow, Evolution of IC Technology, Physical IC Design Flow: Partitioning, Floor Planning , Placement and routing, Types of ASICs.Digital Design issues: Clock Skew, Clock Jitter and Metastability, Static and Dynamic Hazards, Applications of VLSI IC.													8
2	Digital CMOS Circuit Inverter Voltage Transfer Curve(VTC), Power Dissipation, Technology Scaling, MOSFET parasitic, Transmission gates, Lambda Design Rules, CMOS combinational logic design. CMOS sequential logic design. Introduction to Fin-FET, Semiconductor Memories													8
3	Verilog HDL - I Evolution and need of EDA tools, HDL Basics, Verilog: datatypes, system tasks, compiler directives; Hierarchical Modeling Concepts: Top-down and bottom-up design methodology; modules and module instances; Modules and Ports, Compiler directives, Expressions, Operators, Operands in Verilog													8
4	Verilog HDL-II Gate-Level Modeling, Dataflow Modeling, Behavioral Modeling, Structural modeling, Switch level modeling. Structured procedures, Initial and always, blocking and non-blocking statements, Delay control, Conditional statements, Multiway branching, Loops, Sequential and parallel blocks, tasks and functions. Digital circuit design using FSM (Moore and Mealy Machine).													8
5	Design and Synthesis with FPGA Classification of PLDs, ASIC Vs FPGA Design flow, Architecture of FPGA, Programming Technologies, Implementing logic in FPGA, Specification and Application of FPGA, Synthesis of Case statement, Synthesis of if statement, Hardware-Software Co-design Overview													8
													Total Hours	40
Text Books														

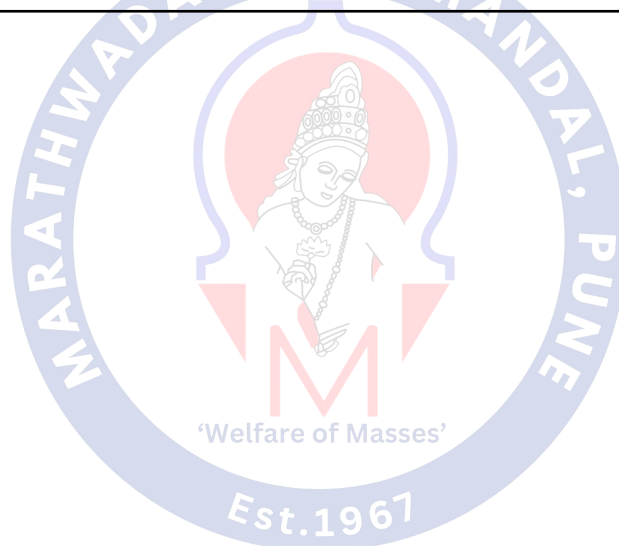
- Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication, (4th Edition), (2010).
- S. Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", Pearson Publication, (3rd Edition), (2010).
- Pong P. Chu, "FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version", WileyInterscience, (1st Edition), (2008).

Reference Book

1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "Digital System Design using Verilog", Cengage India Private Limited, (1st Edition), (2017).
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication, (3rd Edition), (2002)
3. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw-Hill Education, (3rd Edition), (2013).
4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "CMOS Digital Integrated Circuits, Analysis and Design" McGraw-Hill Education, (4th Edition), (2019).

Online References

1. NPTEL Course "Hardware modeling using Verilog" https://onlinecourses.nptel.ac.in/noc23_cs76/preview
2. NPTEL Course " CMOS Digital VLSI Design" https://onlinecourses.nptel.ac.in/noc24_ee29/preview
3. NPTEL Course "VLSI Physical Design with Timing Analysis" https://onlinecourses.nptel.ac.in/noc24_ee77/preview



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC303					Course Name: Control Systems									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Engineering Mathematics I and II, Signals and Systems														
Course Objectives: • To model electrical, mechanical, and electromechanical systems using standard mathematical techniques. • To assess system stability using Routh–Hurwitz, pole–zero analysis, and root locus methods. • To analyze system performance using frequency response techniques such as Bode, polar, and Nyquist plots. • To evaluate transient and steady-state responses of standard first- and second-order systems. • To apply classical controllers P, PI, PD, PID and understand their role in digital and IoT-based industrial automation. Course Outcomes: After completing the course, the students will be able to: CO1: Analyze the physical and graphical control systems. CO2: Analyze the stability of control systems using Routh Hurwitz and root-locus techniques. CO3: Analyze the stability of control systems by applying frequency plot techniques. CO4: Analyze the time domain analysis techniques for a closed-loop control system. CO5: Apply the role of the digital controllers in Industrial automation.														
Unit	Contents													Hrs
1	Introduction to Control Systems & its Modeling Basic elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph, Practical Case-study -EV charger.													8
2	Stability Analysis Characteristic equation of a system, concept of pole and zero, response of various pole locations in s-plane, concept of stability absolute stability, relative stability, stability of system from pole locations, Routh Hurwitz stability criterion, Root locus: definition, magnitude and angle conditions, construction of root locus, concept of dominant poles, effect of addition of pole and zero on root locus. Application of root locus for stability analysis.													8
3	Frequency domain Analysis Frequency response and frequency domain specifications, correlation between time domain and frequency domain specifications, polar plot, Nyquist stability criterion and construction of Nyquist plot, Bode plot, determination of frequency domain specifications and stability analysis using Nyquist plot and Bode plot.													8
4	Time domain Analysis Time domain analysis: transient response and steady state response, standard test inputs for time domain analysis, order and type of a system, transient analysis of first													8

	and second order systems, time domain specifications of second order under damped system from its step response, Steady state error and static error constants.	
5	Controllers and Digital Control Systems Concept of Controller, Basic ON-OFF Controller, Concept of Dead Zone, Introduction to P, I, D, PI, PD and PID controller, OFFSET of Controller, Integral Reset, PID Characteristics. Concept of Zeigler Nicholas method. Concept of Industrial Automation, Need of IoT based Industrial Automation. Applications to Industrial Automation and process control systems.	7
Total Hours		39
Text Books		
1. N. J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition. 2. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited; 5th Edition. 3. K.Chennai Venkatesh & D.Ganesh Rao,, "Control Systems", 1st Edition, 2017.		
Reference Book		
1. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition. 2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition. 3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill. 4. John J. D'Azzo and Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc. 5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley. 6. Control System Engineering, R Anandanatarajan, P Ramesh Babu, SCITECH Publications, Chennai, 2nd edition, 2010.		
Online References		
1. NPTEL Course: Prof. C. S. Shankar Ram, IIT Madras, "Control Systems" [https://nptel.ac.in/courses/107106081/] 2. NPTEL Course: Prof. G. R. Jayanth, IISc Bangalore, "Control System Design" [https://nptel.ac.in/courses/115/108/115108104/]		

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PEC304A						Course Name: Advanced Microcontroller and Applications (Elective 1)								
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Basic C Programming, Analog and Digital Electronics														
Course Objectives: - To provide foundational knowledge of embedded systems and microcontroller architectures. - To develop proficiency in Embedded C programming and register-level hardware control. - To explain ARM Cortex-M architecture and enable students to work with STM32 microcontrollers. - To train students to interface microcontrollers with common peripherals, sensors, and actuators. - To equip students with skills for embedded software development, configuration, debugging, and troubleshooting. Course Outcomes: After completing the course, the students will be able to: CO1: Illustrate embedded systems and microcontroller architectures. CO2: Analyze Embedded C programming and register-level operations. CO3: Illustrate ARM Cortex-M architecture and STM32 microcontroller features. CO4: Illustrate interfacing of sensors, actuators, and peripherals. CO5: Apply embedded development, configuration, and debugging tools.														
Unit	Contents													Hrs
1	Introduction to Microcontrollers and Embedded Systems Overview of embedded systems, Microcontroller vs. Microprocessor, Microcontroller architecture basics, Applications of microcontrollers, Introduction to ARM architecture and Cortex-M series.													6
2	Programming Basics for Embedded Systems Embedded C fundamentals, Writing and compiling embedded programs, Bitwise operations and register-level programming, GPIO programming, input/output, LEDs, buttons, Delay generation techniques													8
3	ARM Cortex-M Architecture and STM32 Overview ARM Cortex-M0/M3/M4 architecture overview Registers, pipelines, and instruction set , Introduction to STM32F4 microcontrollers, STM32 development tools: STM32CubeIDE, STM32CubeMX Setting up a basic STM32 project.													8
4	Peripherals and Interfacing Timers and PWM basics, UART, SPI, and I2C communication, ADC usage with sensors like temperature, IR , Simple actuator control like DC motors, buzzers.													9
5	Embedded Software Development and Debugging Embedded software development lifecycle, STM32CubeMX for peripheral initialization, Interrupts and NVIC basics, Debugging with STM32CubeIDE.													8

Total Hours		39
Text Books		
1. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Newnes, 2014, 3rd Edition. 2. Joseph Yiu, "The Definitive Guide to ARM Cortex-M0 and Cortex-M0+ Processors", Newnes, 2015, 2nd Edition. 3. R. Kamal, "Embedded Systems: Architecture, Programming and Design", McGraw-Hill Education, India, 2016, 2nd Edition. 4. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "ARM Cortex-M Microcontroller Programming and Interfacing", Mazidi Publishing/Prentice Hall, 2017, 1st Edition. 5. STMicroelectronics, "STM32 Microcontroller Reference Manual (RM0090) and Datasheets", STMicroelectronics, Latest Edition.		
Reference Book		
1. Jonathan Valvano, "Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers", CreateSpace Independent Publishing, USA, 2015, 2nd Edition. Michael J. Pont, "Embedded C", Pearson Education, India, 2008, 2nd Edition. 2. Jack Ganssle, "The Art of Designing Embedded Systems", Newnes, USA, 2008, 2nd Edition. 3. James A. Langbridge, "Professional Embedded ARM Development", Wrox Publishing, USA, 2014, 1st Edition. 4. Geoffrey Brown, "Discovering the STM32 Microcontroller", Indiana University Press, USA, 2020, 1st Edition.		
Online References		
1. NPTEL Course: Prof. Anupam Basu, IIT Kharagpur, "Embedded Systems Design - Video Courses" [https://nptel.ac.in/courses/106105159/] 2. NPTEL Course: Prof. Indranil Sengupta & Prof. Kamalika Dutta, IIT Kharagpur, "Embedded System Design with ARM - Video Course" [https://nptel.ac.in/courses/106105193/] 3. NPTEL Course: Prof. Dhananjay V. Gadre & Prof. Badri Subudhi, Netaji Subhas University of Technology and IIT Jammu, "Introduction to Embedded System Design - Video Course" [https://nptel.ac.in/courses/108102169/]		

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PEC304B					Course Name: Digital Signal Processing (Elective 1)									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Engineering Mathematics I and II, Signals and Systems														
Course Objectives: • Explain the sampling, aliasing and block schematic of digital signal processing. • Analyze digital systems using Z-transform and transform techniques. • Apply DFT, FFT, and DCT for analysis of discrete-time signals. • Design IIR digital filters for given specifications. • Design FIR digital filters using appropriate methods. Course Outcomes: After completing the course, the students will be able to: CO1: Interpret discrete signals and represent DSP systems. CO2: Analyze the digital systems using the Z-transform techniques. CO3: Implement efficient transform and its application to analyze DT signals. CO4: Design and implement IIR filters. CO5: Design and implement FIR filters.														
Unit	Contents													Hrs
1	Introduction to Digital Signal Processing Sampling theorem in time domain, recovery of analog signals, and analytical treatment with examples, mapping between analog frequencies to digital frequency, Concept of Interpolation and decimation in signal processing, Representation of signals as vectors, concept of Basis function and orthogonality, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.													8
2	Z-Transform Need for Z-transform, Definition, Relation between Laplace transform and Z-transform, Relation between Fourier transform and Z-transform. Concept of ROC and Properties of ROC, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Solution of difference equations using Z transform. Realization of Digital IIR and FIR Filters.													8
3	Discrete Fourier Transform Frequency-domain sampling, DFT, Properties of DFT, Circular convolution, Computation of linear convolution using circular convolution. Fast Fourier Transform(FFT), FFT algorithms- decimation in time (DIT) and decimation in frequency(DIF) using Radix-2 FFT algorithm for 4 point and 8 point sequences, DFT & FFT computation complexity for 4 point and 8 point sequences. Linear filtering (Block convolution or Long sequence convolution) using overlap add and overlap save method.													8
4	Digital IIR Filters													8

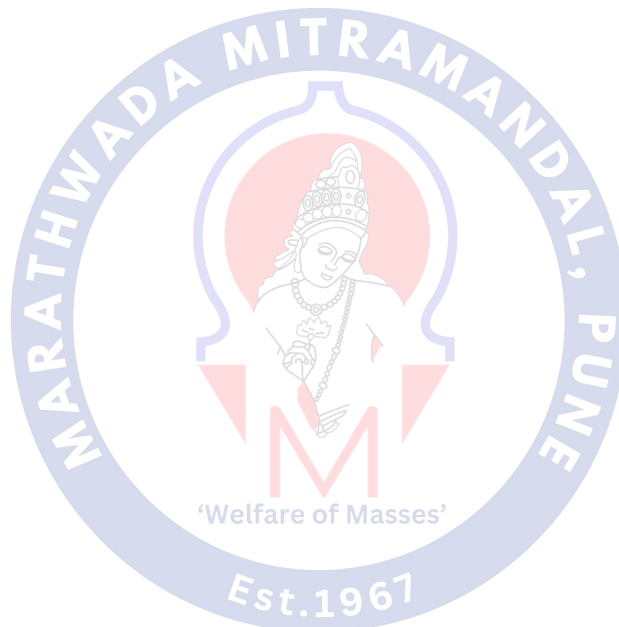
	Concept of analog filter design, IIR filter design methods, Butterworth filter design, Characteristics of Butterworth filters and Chebyshev filters. IIR filter realization using direct form, cascade form and parallel form. Finite word length effect in IIR filter design.	
5	Digital FIR Filters Concept of Windowing techniques, Gibbs phenomenon, Characteristics and comparison of different window functions. Concept of Linear phase conditions, impulse and phase and group delays, Design of linear phase FIR filter using windows, Magnitude and Phase response of Digital filters, Frequency response of Linear phase FIR filters. FIR filter realization using Direct Form, Cascade and linear phase structure. Digital filters used for noise removal in Image processing and Speech processing applications.	8
Total Hours		40
Text Books		
1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Prentice Hall, 4th Edition. 2. S. Salivahanan, C. Gnanapriya, "Digital Signal Processing", McGraw Hill, 2nd Edition		
Reference Book		
1. Ifeachor E.C, Jervis B. W, "Digital Signal Processing : Practical approach", Pearson Publication, 2nd Edition. 2. Li Tan, "Digital Signal Processing : Fundamentals and Applications", Academic Press, 3rd Edition. 3. Schaum's Outline of "Theory and Problems of Digital Signal Processing", 2nd Edition. 4. Oppenheim, Schafer, "Discrete-time Signal Processing", Pearson Education, 1st Edition. 5. K.A. Navas, R. Jayadevan, "Lab Primer through MATLAB", PHI, Eastern Economy Edition.		
Online References		
1. NPTEL Course on "Digital Signal Processing" Link of the Course: https://nptel.ac.in/courses/117/102/117102060/ 2. NPTEL Course on "Digital Signal Processing" Link of the Course: https://nptel.ac.in/courses/108/105/108105055/		

'Welfare of Masses'

Est.1967

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code:ET24PEC304C					Course Name: Database Management System (Elective 1)									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Data Structures and Algorithms, Fundamentals of Programming Languages, Object Oriented Programming														
Course Objectives: • To explain the concepts and applications of database management. • To discuss different models and normalization used for database design. • To use query languages in databases. • To understand NoSQL Databases to handle unstructured data. • To understand big data and the Hadoop ecosystem. Course Outcomes: After completing the course, the students will be able to: CO1: Explain the concepts of DBMS and Big Data. CO2: Apply Structured Query Language on a relational database to retrieve data. CO3: Apply the knowledge of NoSQL databases to handle unstructured data. CO4: Apply the transaction management algorithms for the given tasks.														
Unit	Contents													Hrs
1	Introduction to DBMS Database Concepts, Database System Architecture, Data Models, entity, attributes, relationships, constraints, keys, E-R Model, EER Model. Relational Model, Attributes and Domains, Referential Integrities. Relational Algebra: Basic Operations. Database Design, Functional Dependency, Purpose of Normalization, Data Redundancy, Anomalies. Normal forms Introduction to SQL, SQL Data Types, DDL, DML, and DCL queries, Views, Indexes, Null handling, Nested Queries. PLSQL, Query optimization. Introduction to NoSQL databases, special-purpose databases- Temporal, Spatial, In-memory, Multimedia databases, vector databases, etc.													7
2	Database Transaction Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability, Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules.													8
3	Concurrency Control and Advanced Database Architectures Concurrency Control, Locking Methods, Deadlocks, Protocols, Recovery Methods, Database Architectures, Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Indexing and hashing, Parallel Databases, Distributed Databases													8
4	NoSQL and semi-structured Data Management Structured and unstructured data, NoSQL- Comparative study of SQL and NoSQL databases. BASE Properties, Types of NoSQL databases- Key-value store, Document Store, Column store, and Graph-based, Create, Retrieve, Update, and Delete (CRUD) Operations.													8
5	Big Data Ecosystem Big data overview, characteristics of Big Data, applications of Big Data, challenges enabling real time big data processing, Hadoop ecosystem, MapReduce Working, the Mapper and Reducer, drivers of Big Data, Emerging Big Data Ecosystem, Data Analytics Life cycle. Data lakes and data warehouses, Ethics in DBMS.													8

Total Hours		40
Text Books		
1. Silberschatz A., Korth H., Sudarshan S, Database System Concepts, McGraw-Hill Publication, ISBN-0-07-120413-X, Sixth Edition, (2011) 2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Publication, ISBN-13: 978-0-136-08620-8, 6th Edition, (2011). 3. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, (2013)		
Reference Book		
1. Reema Thareja, Data warehousing, Oxford University Press, ISBN 0195699610, 1st Edition, (2009) 2. Raghu Ramakrishnan and Johannes Gehrke, 'Database Management Systems', McGraw-Hill, (3rd Edition), (2003) 3. Shashak Tiwari, " Professional NoSQL", Wiley Publication, 1st Edition, (2011)		
Online References		
1. NPTEL "Database management systems" https://onlinecourses.nptel.ac.in/noc22_cs91/ 2. NPTEL "Introduction to Database Systems" https://onlinecourses.nptel.ac.in/noc25_cs40/		

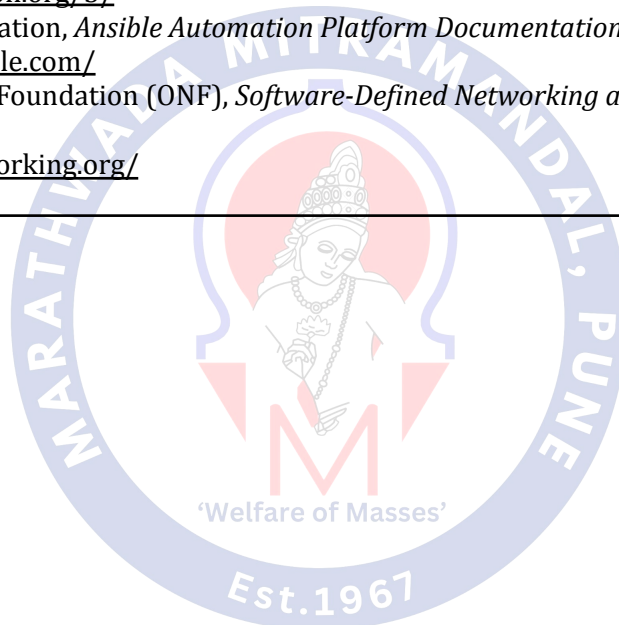


Third Year B. Tech Electronics and Telecommunication Engineering															
Semester V															
Course Code: ET24PEC304D					Course Name: Computer Networks (Elective 1)										
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL	
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3	
Prerequisite: -															
Course Objectives:															
- Understand the architecture, protocols, and layered models of computer networks. - Develop knowledge of IPv4/IPv6 addressing, switching technologies, and routing concepts. - Develop skills in configuring routers, switches, and network services using Cisco networking tools. - Understand network security principles and troubleshooting techniques for enterprise networks. - Explore emerging networking technologies, including SDN, network automation, virtualization, cloud networking, and IoT.															
Course Outcomes:															
After completing the course, the students will be able to:															
CO1: Understand the architecture, protocols, and layered models of modern computer networks.															
CO2: Design IPv4/IPv6-based networks using switching technologies, VLANs, and inter-VLAN routing.															
CO3: Configure routers and routing protocols for communication across networks.															
CO4: Analyze network services, security mechanisms, and troubleshooting techniques for enterprise networks.															
CO5: Apply network management, monitoring, troubleshooting tools, and emerging networking technologies including SDN, network automation, virtualization, cloud networking, and IoT.															
Unit	Contents														Hrs
1	Fundamentals of Computer Networks: Introduction to computer networks and the Internet; types of networks (LAN, WAN, MAN, PAN, SAN); network topologies; network devices; transmission media; OSI Reference Model; TCP/IP Model; protocol encapsulation; data flow; protocol data units (PDUs); MAC addressing; Ethernet standards; switching and routing concepts; introduction to Cisco networking, Cisco IOS, CLI basics, and Cisco device components.														8
2	IP Addressing and Switching Technologies: IPv4 addressing concepts including address classes, private and public addressing, CIDR, VLSM, and subnetting; IPv6 fundamentals, address types, address representation, and Stateless Address Autoconfiguration (SLAAC); Ethernet switching concepts including switch operation, MAC address table, collision and broadcast domains; VLAN concepts, VLAN configuration, trunking (IEEE 802.1Q), inter-VLAN routing, and Router-on-a-Stick configuration.														8
3	Routing Fundamentals:														8

	Introduction to routing concepts including routing tables, packet forwarding, and default gateways; static routing with static routes, default routes, and floating static routes; dynamic routing concepts including distance vector and link-state routing protocols; RIP configuration and its limitations; and OSPF fundamentals covering areas, router IDs, neighbor relationships, and single-area OSPF configuration.	
4	Network Services and Security: Introduction to network services including DHCP, DNS, NAT, and PAT; wireless networking concepts covering WLAN architecture, access points, wireless standards, and wireless security; network security fundamentals including the CIA triad, common network threats, access control lists (ACLs), firewalls, VPN concepts, and basic device hardening; and an introduction to AAA (Authentication, Authorization, and Accounting) for secure network access management.	8
5	Network Management, Troubleshooting and Emerging Technologies: Introduction to network troubleshooting using the layered troubleshooting methodology, including tools such as Ping, Traceroute, Telnet, SSH, Cisco show and debug commands; packet analysis using Wireshark for packet capture and protocol analysis; network monitoring with SNMP, Syslog, and NTP; and emerging networking technologies including Software Defined Networking (SDN), network virtualization, cloud networking, network automation, Python basics, REST APIs, Ansible concepts, IoT networking, and an overview of Cisco DNA Center.	8
Total Hours		39
Text Books		
1. James F. Kurose and Keith W. Ross, <i>Computer Networking: A Top-Down Approach</i>, 8th Edition, Pearson Education, 2021. 2. Andrew S. Tanenbaum and David J. Wetherall, <i>Computer Networks</i>, 6th Edition, Pearson Education, 2021. 3. Rick Graziani and Allan Johnson, <i>Routing and Switching Essentials Companion Guide</i>, Cisco Networking Academy, Cisco Press, 2nd Edition, 2018. 4. Allan Johnson, <i>Introduction to Networks Companion Guide (CCNAv7)</i>, Cisco Networking Academy, Cisco Press, 2nd Edition, 2020. 5. Wendell Odom, <i>CCNA 200-301 Official Cert Guide Library</i>, Cisco Press, 2nd Edition, 2024.		
Reference Book		
1. William Stallings, <i>Data and Computer Communications</i>, 11th Edition, Pearson Education, 2020. 2. Douglas E. Comer, <i>Computer Networks and Internets</i>, 6th Edition, Pearson Education, 2015. 3. Gary A. Donahue, <i>Network Warrior</i>, 3rd Edition, O'Reilly Media, 2017. 4. W. Richard Stevens and Kevin R. Fall, <i>TCP/IP Illustrated, Volume 1: The Protocols</i>, 2nd Edition, Addison-Wesley Professional, 2011. 5. William Stallings, <i>Network Security Essentials: Applications and Standards</i>, 7th Edition, Pearson Education, 2022. 6. Joseph Migga Kizza, <i>Guide to Computer Network Security</i>, 5th Edition, Springer, 2020. 7. Matthew Castelli, <i>Computer Networking Problems and Solutions: An Innovative Approach to Building Resilient, Modern Networks</i>, Apress, 2022. 8. George Varghese, <i>Network Algorithmics: An Interdisciplinary Approach to Designing Fast Networked Devices</i>, Morgan Kaufmann, 2005.		

Online References

1. Cisco Networking Academy, *CCNA and Networking Courses*.
<https://www.netacad.com/>
2. RFC Editor, *Internet Standards (RFC Repository)*.
<https://www.rfc-editor.org/>
3. NPTEL Course, *Computer Networks – Prof. Sujoy Ghosh, IIT Kharagpur*.
<https://nptel.ac.in/courses/106105183>
4. IEEE Xplore Digital Library, *Research Articles on Computer Networks and Communication*.
<https://ieeexplore.ieee.org/>
5. Internet Society (ISOC), *Networking Standards and Internet Resources*.
<https://www.internetsociety.org/>
6. Wireshark Foundation, *Wireshark User Guide and Documentation*.
<https://www.wireshark.org/docs/>
7. Cisco Developer, *Network APIs and Automation Resources*.
<https://developer.cisco.com/>
8. Python Software Foundation, *Python Documentation*.
<https://docs.python.org/3/>
9. Ansible Documentation, *Ansible Automation Platform Documentation*.
<https://docs.ansible.com/>
10. Open Networking Foundation (ONF), *Software-Defined Networking and Open Networking Resources*.
<https://opennetworking.org/>



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code:ET24MDM305					Course Name: Microcontrollers & Embedded Software									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: C- Language, Digital Circuits														
Course Objectives: - To illustrate the fundamentals of embedded systems and microcontroller platforms such as Arduino and ESP32. - To demonstrate programming skills using Embedded C and SDK-based environments. - To describe architectural features, peripherals, and development workflows of Arduino and ESP32. - To demonstrate the interfacing of sensors, actuators, and communication peripherals across multiple development boards. - To apply debugging techniques, firmware uploading methods, and embedded development practices for real-time applications. Course Outcomes: After completing the course, the students will be able to: CO1: Illustrate the structure and functional components of embedded systems and microcontroller platforms. CO2: Illustrate programs using Embedded C and board-specific SDKs for Arduino and ESP32. CO3: Describe the architecture, features, and peripheral capabilities of microcontrollers. CO4: Interface sensors, actuators, and peripherals using digital, analog, and communication protocols. CO5: Apply debugging tools, firmware upload procedures, and troubleshooting techniques in embedded applications.														
Unit	Contents													Hrs
1	Introduction to Microcontrollers and Embedded Systems: Embedded systems overview, Microcontroller vs. Microprocessor, Introduction to Arduino, ESP32 platforms, Applications in IoT and Industrial automation.													8
2	Programming Basics for Embedded System: Embedded C programming for Arduino and ESP32, GPIO operations, LED and switch interfacing, Delay generation methods.													8
3	Microcontroller Platforms and Toolchains : Overview of Arduino Uno, ESP32 DevKit, IDEs : Arduino IDE, ESP-IDF, Basic project setup, Code uploading procedures.													6
4	Peripherals and Interfacing: Timers and PWM, UART, SPI, I2C communication protocols, ADC , Wi-Fi connectivity, Bluetooth interfacing , Sensor interfacing like temperature, IR, ultrasonic, Actuators like motors, buzzers, relays.													9
5	Embedded Software Development and Debugging: Introduction to firmware uploading on Arduino and ESP32, interrupt handling techniques, basics of multitasking using ESP32 FreeRTOS, and usage of serial debugging tools.													8
Total Hours														39
Text Books														

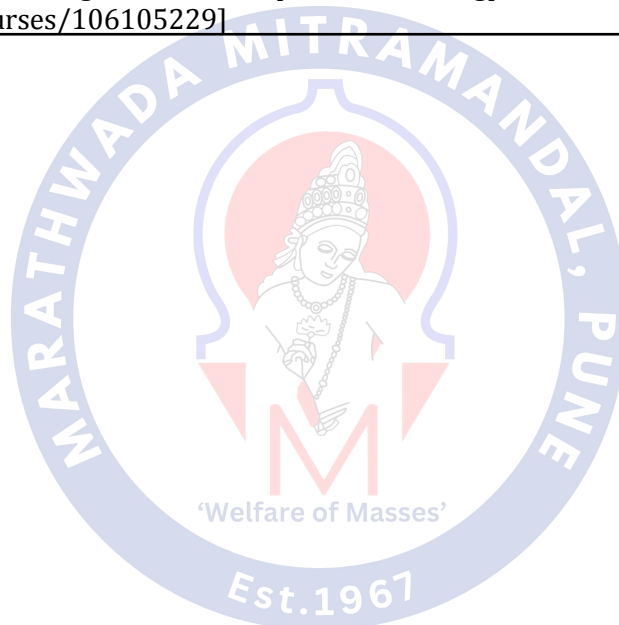
1. Massimo Banzi and Michael Shiloh, "Getting Started with Arduino", Maker Media, USA, 2014, 3rd Edition.
2. Neil Kolban, "Kolban's Book on ESP32", Leanpub Publishing, USA, 2018, 1st Edition.
3. John Boxall, "Arduino Workshop: A Hands-On Introduction with 65 Projects", No Starch Press, USA, 2013, 1st Edition.

Reference Books

1. Jonathan Oser and Hugh Blemings, "Practical Arduino: Cool Projects for Open Source Hardware", Apress, USA, 2009, 1st Edition.
2. Marco Schwartz, "Internet of Things with ESP8266", Packt Publishing, UK, 2016, 1st Edition.
3. Peter Dalmaris, "ESP32 Development Using the Arduino IDE", Elektor International Media, Netherlands, 2020, 1st Edition.

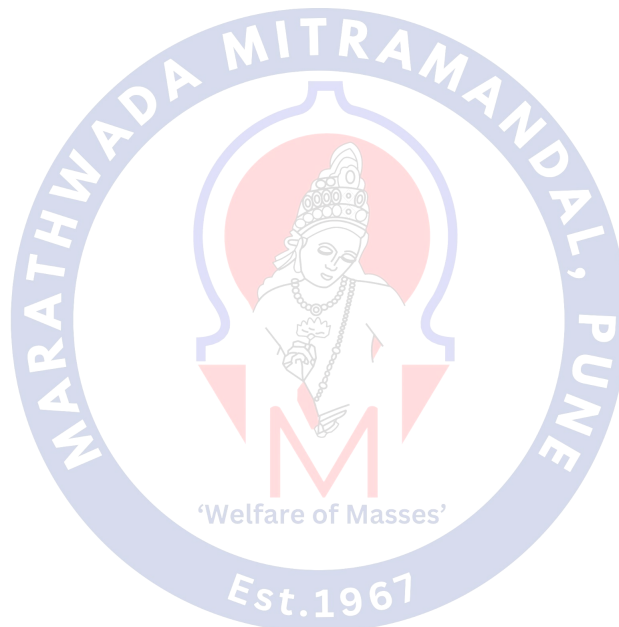
Online References

1. NPTEL Course: Prof. Dhananjay V. Gadre & Prof. Badri Subudhi, Netaji Subhas University of Technology and IIT Jammu, "Introduction to Embedded System Design - Video Course"
[<https://nptel.ac.in/courses/108102169/>]
2. MOOC Course: Ian Harris, University of California, Irvine, "Introduction to IoT – Coursera"
[<https://www.coursera.org/learn/iot>]
3. NPTEL Course: Rajib Mall, Durga Prasad Mohapatra, IIT Kharagpur, "Real-Time Systems"
[<https://nptel.ac.in/courses/106105229>]



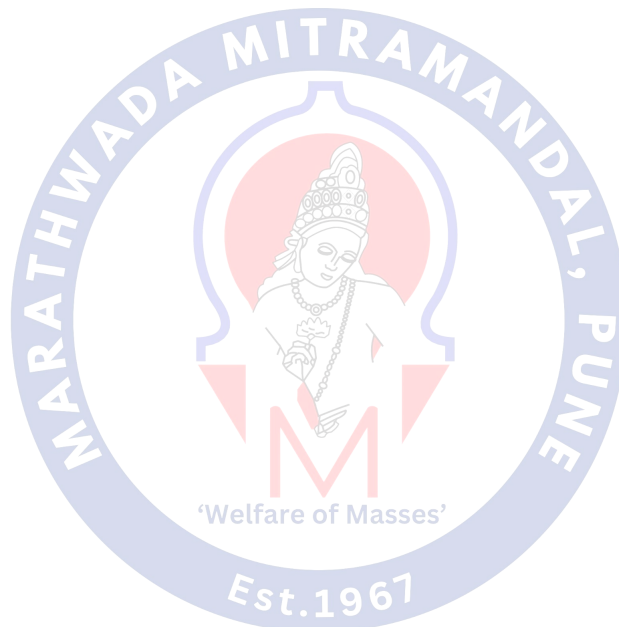
Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC306					Course Name: Analog and Digital Communication Systems Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	50	-	50		1	-	1
Prerequisite: Basic of Electronics Technology, Signals and Systems														
Course Objectives:														
- To generate and analyze different types of Amplitude modulated signals. - To generate and analyze different types of frequency modulated signals. - To illustrate the significance of the Sampling theorem at different sampling rates. - To interpret different types of digital to digital conversion techniques.														
Course Outcomes:														
After completing the course, the students will be able to:														
CO1: Generate and analyze different types of Amplitude modulated signals.														
CO2: Generate and analyze different types of frequency modulated signals.														
CO3: Interpret the importance of Sampling Theorem and analog to digital conversion.														
CO4: Illustrate the digital to digital conversion techniques.														
List of Experiments														
Sr. No.	Contents													Hrs
Hardware Practicals														
1.	Generate different types of Amplitude modulated signal with the help of Balanced Modulator and detect the modulating signal. Calculate the modulation index of an Amplitude modulated signal using envelope and trapezoidal method.													2
2.	Calculate modulation Index and bandwidth of a Frequency modulated signal. Observe and draw the output signal of FM demodulator. Verify the results with Bessel's function.													2
3.	Observe and draw the effect of different sampling rate on sampled signal and reconstructed signal, observe and draw Aliasing effect in frequency domain.													4
4.	Generate and receive the Pulse Code Modulated signal.													2
5.	Observe and draw different Line Codes.(Pulse shaping, raise cosine).													2
Software Assignments														
6.	Write a program to sample a continuous time signal at different sampling frequencies and reconstruct the analog signal from its samples. Show Aliasing effect by varying the sampling frequency.													2
7.	Introduction to GNU Radio platform (Linux based).													4
Mini project/Case Study/ Survey (Any One)														
8.	Walky Talky													8
	Recent trends in communication.													8
	Communication standards.													8
Total Hours													26	
Note: Students can take up an assignment of his/her choice in a group of 4 to 5 students. A demonstration of the same needs to be given along with a technical report during the submission of the assignment.														

Text Books	
1. Dennis Roddy and John Coolen. <i>Electronic Communication</i>, 4th ed., Pearson Education, 2009. 2. B. P. Lathi and Zhi Ding, <i>Digital and Analog Communication System</i>, 4th ed., Oxford University Press, 2010.A. B. Carlson and Paul B. Crilly, <i>Communication Systems</i>, 5th ed., Tata McGrawHill, 2010. 3. Shanmugam K.S, <i>Digital & Analog Communication Systems</i> John Wiley & Sons, NewYork, Jan 2012.	
Reference Book	
1. Simon Haykin, <i>Introduction To Analog & Digital Communications</i>, 2nd ed., Wiley India Pvt. Ltd., 2008. 2. Wayne Tomasi, <i>Advanced Electronic Communications Systems</i>, 6th ed., Pearson Education Limited, 2014.	
Online References	
1. Aditya K. Jagannatham. <i>Principles of Communication Systems</i>. NPTEL, https://nptel.ac.in/courses/108/104/108104091/	



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code:ET24PCC307					Course Name: VLSI Design Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1
Prerequisite: Fundamentals of Digital Electronics, Basic Electronic Devices and Circuits														
Course Objectives:														
- To prepare CMOS layout in selected technology, simulate with & without capacitive load, comment on rise & fall times. - To model digital logic design, simulate, synthesize and implement it on PLD.														
Course Outcomes:														
After completing the course, the students will be able to:														
CO1: To design CMOS layout for the given digital logic.														
CO2: To apply concepts of Verilog HDL for combinational and sequential digital design.														
CO3: To simulate, synthesize, and prototype a design using PLD.														
List of Practicals														
Sr. No.	Contents													Hrs
1.	Introduction													2
2.	Design, Simulate and verify the operation of CMOS Inverter and measure delays and power.													2
3.	Design , Simulate and verify the operation of CMOS NAND Gate .													2
4.	Layout and its verification for CMOS NAND Gate .													4
5.	PLD Design Flow.													2
6.	Introduction to usage of GPIOs and other resources on PLDs													2
7.	Model a Combinational circuit using Verilog and implement it using PLD.													2
8.	Model a Sequential circuit using Verilog and implement it using PLD.													2
9.	Model SRAM using Verilog and implement it using PLD.													2
10.	Design and model Finite state machine using Verilog and implement it using PLD.													2
11.	Miniproject(Using Verilog): Design and implement ALU/Traffic Light controller /vending machine / any other													4
													Total Hours	26
Text Books														
1. S. Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", Pearson Publication, (3rd Edition), (2010).														
2. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication, (4th Edition), (2010).														
3. Pong P. Chu, "FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version", WileyInterscience, (1st Edition), (2008).														

Reference Books	
1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "Digital System Design using Verilog", Cengage India Private Limited, (1st Edition), (2017). 2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication, (3rd Edition), (2002). 3. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw-Hill Education, (3rd Edition), (2013). 4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "CMOS Digital Integrated Circuits, Analysis and Design" McGraw-Hill Education, (4th Edition), (2019).	
Online References	
1. NPTEL Course "Hardware modeling using Verilog" https://onlinecourses.nptel.ac.in/noc23_cs76/preview 2. NPTEL Course "CMOS Digital VLSI Design" https://onlinecourses.nptel.ac.in/noc24_ee29/preview 3. NPTEL Course "VLSI Physical Design with Timing Analysis" https://onlinecourses.nptel.ac.in/noc24_ee77/preview	



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC308					Course Name: Engineering Design and Innovation-I									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	4	-	-	-	-	-	25	-	-	25	-	2	-	2
Prerequisite: 1. Project Based Learning 2. EDA tools such as Multisim, Proteus, KiCad, MATLAB/Simulink														
Course Objectives: 1. To apply the knowledge acquired from foundational engineering courses to solve engineering problems. 2. To develop the ability to design, model, simulate, fabricate, and validate engineering systems or prototypes using appropriate tools and techniques. 3. To strengthen analytical thinking, innovation, and project management skills through the execution of a project. 4. To improve teamwork, technical documentation, presentation, and communication skills while adhering to professional, ethical engineering practices.														
Course Outcomes: After completing the course, the students will be able to: C01: Identify an engineering problem, by integrating knowledge from multiple foundational engineering courses. C02: Develop a functional engineering solution (prototype, software, hardware, process, or experimental setup) using appropriate engineering principles, tools, software, simulation techniques, and fabrication methods. C03: Execute engineering projects effectively as a team by planning project activities, maintaining documentation and progress records, integrating individual contributions, and validating the developed solution through testing, performance evaluation, and continuous improvement. C04: Demonstrate effective technical communication by presenting, demonstrating, and documenting the project work.														
Mini Project														
Course Philosophy: Engineering Design and Innovation-I enables students to integrate the knowledge and skills acquired from first- and second-year foundational engineering courses to solve engineering problems. The course promotes design thinking, innovation, and project-based learning by encouraging students to identify problems, develop engineering solutions, use appropriate software and hardware tools, and validate their designs through experimentation, teamwork, and effective technical communication.														
Design Readiness & Skill Development: As a part of Engineering Design and Innovation-I, each project group shall develop proficiency in one engineering skill group aligned with its project domain. Each project group shall support the design, simulation, implementation, testing, or validation of the proposed solution and be integrated throughout the project lifecycle rather than conducted as a separate laboratory activity. Through hands-on application, students will develop practical engineering skills that enhance project execution and design readiness.														

Assessment & Evaluation Guidelines:

3 to 4 students are permitted in a group depending on theme and complexity. It is recommended that regular assessment of student's work to be done and Continuous Internal Evaluation record is to be maintained by all mentors/departments.

Guidelines for Presentation & Report writing :

A project report with following contents shall be prepared:

- ☐ Title
- ☐ Abstract
- ☐ Introduction & Motivation
- ☐ Literature Survey
- ☐ Problem statement & Objectives
- ☐ System Block Diagram & Description
- ☐ Hardware Schematic and Software Tools (Algorithm) required
- ☐ Design and Implementation
- ☐ Results & Discussion
- ☐ Advantages & Limitations
- ☐ Applications
- ☐ Conclusion and Future Scope
- ☐ References
- ☐ Annexures/Data sheets

Activity List :

- Group formation, Identify & Analyze problem statement, Set objectives, and Finalize the project title
- Submission of Literature Survey, Problem statement through literature survey and abstract based on idea of project
- Review : Introduction, Aim, Objectives, and System Block diagram.
- Design using an appropriate EDA tool, Simulation.
- Detailing of hardware and software, system Implementation Details.
- Testing & validation of the final product.
- Submission of Report.
- Demonstration & Group Presentations.
- Paper publication/Poster if any and Submission.

Text Books

Reference Books

1. FraJohn Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning", ASCD, 2015.
2. John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences", ASCD, 2018
3. Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry". M. Krašna, "Project based learning (PBL) in the teachers' education,"39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2016, pp. 852-856, doi: 10.1109/MIPRO.2016.7522258.
4. J. Macias- Guarasa, J.M. Montero, R. San-Segundo, A. Araujo and O. Nieto-Taladriz, "A project-based learning approach to design electronic systems curricula", IEEE transactions on Education, vol.49, no. 3, pp. 389-397, Aug. 2006, doi: 10.1109/TE.2006.879784.

Online References

1. Electronic Packaging and Manufacturing, IIT Kharagpur Prof. Anandaroop Bhattacharya Prof. Goutam Chakraborty: <https://nptel.ac.in/courses/112105267>

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24MDM309					Course Name: Microcontrollers & Embedded Software Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	1
Prerequisite: C- Language, Digital Circuits														
Course Objectives:														
- To illustrate the fundamental concepts of embedded systems and features of Arduino and ESP32 microcontroller platforms. - To develop and debug Embedded C-based firmware using board-specific development environments for reliable embedded applications. - To implement embedded systems by interfacing sensors, actuators, and communication modules using digital, analog, and serial protocols.														
Course Outcomes:														
After completing the course, the students will be able to:														
CO1:Illustrate the structure, architecture, features, and functional components of embedded systems and microcontroller platforms.														
CO2: Develop Embedded C programs using SDK-based environments for Arduino and ESP32.														
CO3: Interface sensors, actuators, and communication peripherals using digital, analog, and serial protocols such as UART, SPI, and I2C.														
List of Practicals														
Sr. No.	Contents													Hrs
1.	To Configure the Development Environment for Arduino and ESP32 platforms.													2
2.	To Interface an LED and Toggle It Using Software Delay and Non-Blocking Timing Methods.													2
3.	To Interface a Pushbutton Switch and Control an LED with Debounce Implementation.													2
4.	To Interface a 16×2 LCD and Display Text Messages.													2
5.	To Implement Timer-Based Periodic Tasks Using Software Timers.													2
6.	To Generate PWM Signals and Control Actuators such as DC Motors or Buzzers.													2
7.	To Measure the Period and Frequency of an External Signal.													2
8.	To Transmit and Receive a String Using UART with Interrupt-Based Reception.													4
9.	To Interface an SPI-Based Graphical OLED and Display a Graph or Bitmap Image.													4
10.	To Read Analog Sensor Data Using ADC and Display Filtered Output.													4
													Total Hours	26
Text Books														
1. Massimo Banzi and Michael Shiloh, “Getting Started with Arduino”, Maker Media, USA, 2014, 3rd Edition. 2. Neil Kolban, “Kolban’s Book on ESP32”, Leanpub Publishing, USA, 2018, 1st Edition.														

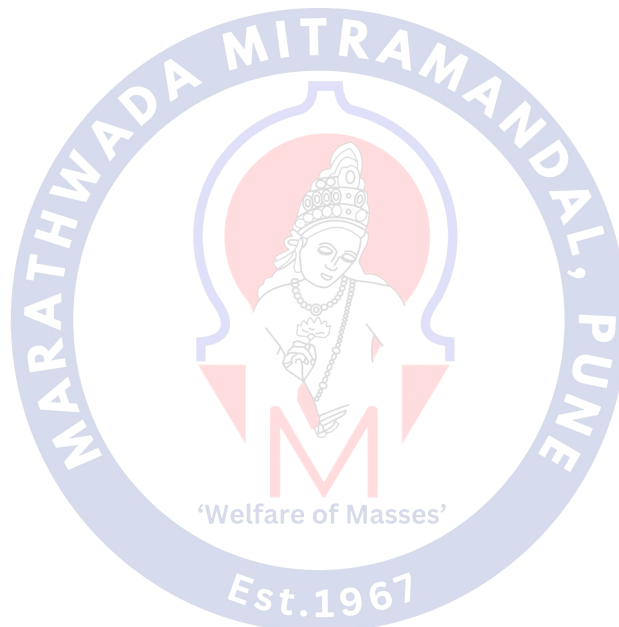
3. John Boxall, "Arduino Workshop: A Hands-On Introduction with 65 Projects", No Starch Press, USA, 2013, 1st Edition.

Reference Books

1. Jonathan Oser and Hugh Blemings, "Practical Arduino: Cool Projects for Open Source Hardware", Apress, USA, 2009, 1st Edition.
2. Marco Schwartz, "Internet of Things with ESP8266", Packt Publishing, UK, 2016, 1st Edition.
3. Peter Dalmaris, "ESP32 Development Using the Arduino IDE", Elektor International Media, Netherlands, 2020, 1st Edition.

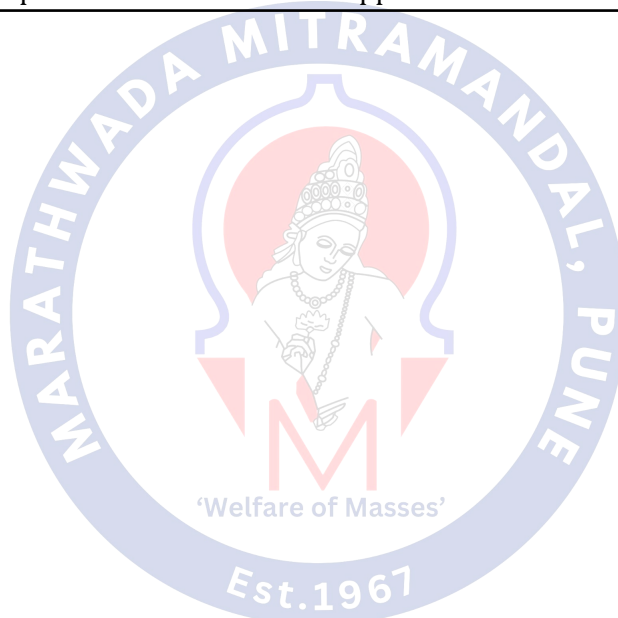
Online References

1. NPTEL Course: Prof. Dhananjay V. Gadre & Prof. Badri Subudhi, Netaji Subhas University of Technology and IIT Jammu, "Introduction to Embedded System Design - Video Course"
[<https://nptel.ac.in/courses/108102169/>]
2. MOOC Course: Ian Harris, University of California, Irvine, "Introduction to IoT – Coursera"
[<https://www.coursera.org/learn/iot>]
3. NPTEL Course: Rajib Mall, Durga Prasad Mohapatra, IIT Kharagpur, "Real-Time Systems"
[<https://nptel.ac.in/courses/106105229>]



Third Year B. Tech Electronics and Telecommunication Engineering															
Semester V															
Course Code: ET240EL310										Course Name: Strategic Management					
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	ODL	TOTAL
-	-	-	-	2	-	-	50	-	-	50	-	-	-	2	2
Prerequisite: Entrepreneurship Skills Development															
Course Objectives:															
• Explain the concepts, scope, and importance of strategic management, strategy, strategic planning, and tactics. • Describe the role of vision, mission, leadership, corporate culture, and ethics in the strategic management process. • Illustrate the strategic management process and its linkage with organizational life cycle, sustainability, and ethical practices. • Apply environmental analysis tools to assess internal and external environments, including resources, capabilities, and industry conditions. • Apply business-level and corporate-level strategy concepts such as generic strategies, Blue Ocean strategy, mergers & acquisitions, and strategy implementation in organizational contexts.															
Course Outcomes:															
After completing the course, the students will be able to:															
CO1: Explain the fundamental concepts, terminology, and frameworks of strategic management.															
CO2: Describe the strategic role of leadership, culture, ethics, sustainability, ESG, and SDGs in organizations.															
CO3: Apply strategic analysis tools such as SWOT, Resource-Based Model, value chain, and industry analysis to real-world business situations.															
CO4: Apply appropriate business-level and corporate-level strategies to support organizational competitiveness and long-term value creation.															
Course Framework															
1	Conceptual foundation of strategy: What is Strategic Management? Concepts of Strategy -I Concepts of Strategy - II Concepts of Strategy - III Strategy, Strategic Plan and Tactics. Strategic Management, Culture and Leadership: Strategic Planning, Thinking and Business Policy Importance of Strategic Management Corporate Culture Leadership														
2	Vision, Mission, Objectives & Strategic Management Process: Developing and Communicating and Strategic Vision Communicating a Strategic Vision Developing Company’s Mission Statement and Linking it with Core Values Strategic Management Process														
3	Strategy and Ethics: Concept of Organizational Life Cycle Generic Competitive Strategies, Ethics as a Strategy Environmental analysis: Sustainability as a Strategic Approach Environment and Strategy Internal Environment Resource Based Model I/O Model, Resources, Capabilities, Core Competencies and Value Chain Industry Life Cycle Competition as Basis for Strategy Formulation & Red Ocean Strategy 30. Blue Ocean Strategy Blue Ocean Strategy: Blue Ocean Strategy, Strategic Entrepreneurship														
4	Strategy can also be looked upon as and for: Strategy for Value creation, Strategy from Different Perspectives: Fortune at the Bottom of the Pyramid, Strategy from Different Perspectives: Capitalism at the Crossroads Strategy from Different Perspectives: Sustainable Value Framework Strategy from Different Perspectives: Development as Freedom.														

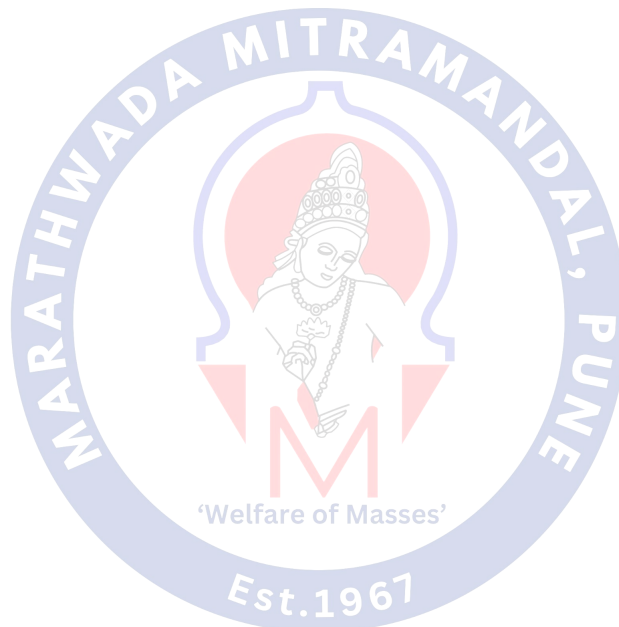
5	Crafting strategies: Designing Business Level Strategies, Designing and Strengthening Business Strategies Corporate Level Strategy, Designing Corporate Level Strategy. Crafting Strategies: Designing and Strengthening Corporate Level Strategy, Strengthening Company's Competitive Position, Mergers and Acquisitions Strategic Execution: Corporate Governance Managing Internal Operations, Strategy Implementation More ways to visualize and think about strategy: Strategy Evaluation , The Black Swan ESG and SDG		
	Total Hours		30
	NPTEL/SWAYAM Courses Under ODL		
	1. Strategic Management - The Competitive Edge, Prof. R Srinivasan 2. Strategic Management, Prof. Vinay Sharma		
Guidelines for Conduction of Course			
1. The student must register for the online course on the NPTEL . 2. The course duration should be at least 12 weeks or more. 3. Students should complete the online assignments, quizzes, projects, etc mentioned under the online course. 4. Once the course is completed the student should appear for the NPTEL course examination			

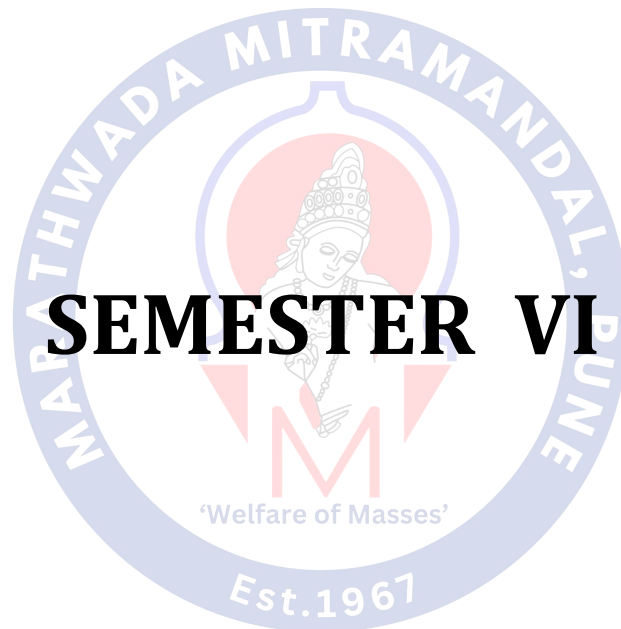


Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24AEC311					Course Name: Reasoning and Aptitude Development I									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	-	1	-	-	-	-	25	-	-	25	-	-	-	1
Prerequisite: Basic Mathematical Concepts														
Course Objectives: 1. To develop fast and accurate mental calculation skills using Vedic Mathematics techniques for arithmetic operations. 2. To strengthen students' understanding of number systems, divisibility rules, and numerical properties for efficient problem solving. 3. To enhance competency in percentages, profit-loss, discounts, ratios, and partnerships for real-life and competitive exam applications. 4. To build logical reasoning abilities through linear, circular, and complex puzzle-based arrangements. 5. To improve analytical thinking by applying concepts of syllogisms, blood relations, and direction sense. 6. To prepare students for aptitude-based assessments and competitive examinations by integrating speed, accuracy, and logical reasoning skills. Course Outcomes: After completing the course, the students will be able to: CO1: Perform rapid mental calculations involving addition, subtraction, multiplication, squaring, square roots, and cube roots with high accuracy. CO2: Analyze and solve number system problems involving divisibility, unit digits, factorials, HCF-LCM, and remainders. CO3: Apply percentage, profit-loss, discount, ratio, and partnership concepts to solve quantitative aptitude problems efficiently. CO4: Solve seating arrangement and puzzle-based problems, including linear, circular, matrix, and scheduling puzzles, using logical reasoning. CO5: Evaluate syllogism problems and blood relation cases using Venn diagrams, family trees, and logical inference. CO6: Demonstrate improved speed, accuracy, and confidence in quantitative and reasoning sections of placement and competitive examinations.														
Unit	Contents													Hrs
1	Vedic Math & Mental Calculation 1. Speed Addition & Subtraction (Left-to-Right method) 2. Base Method Multiplication (Numbers near 10, 100, 1000) 3. Squaring Techniques (Base 50/100 and numbers ending in 5) 4. Cube Roots and Square Roots of perfect numbers													2
2	Number Systems 5. Classification (Rational, Irrational, Prime, Composite) 6. Divisibility Rules (2 to 19) 7. Unit Digit and Cyclicity 8. Factorial theory and Number of Zeroes 9. HCF & LCM (Models: Remainder cases)													2

	10. Remainder Theorem basics	
3	Percentages 11. Percentage Increase/Decrease and Multiplying Factors 12. Successive Percentage Change Formula 13. Product Constancy Rule	2
4	Profit, Loss & Discount 14. CP, SP, and Profit/Loss Percentage 15. Relation between Markup, Discount, and Profit 16. Successive Discounts and Single Equivalent Discount	2
5	Ratio, Proportion & Partnership 17. Ratio Scaling and Merging (A:B and B:C to A:B:C) 18. Mean, Third, and Fourth Proportional 19. Coin-based problems 20. Partnership: Profit sharing based on (Capital $\times$ Time) 21. Problems on Ages	2
6	Linear Arrangements 22. Single Row: All facing North/South 23. Dual Row: Facing each other 24. Directional cues (Left of, Second to the right, Immediate neighbours) 25. Ranking and Ordering (Tallest/Shortest, Top/Bottom)	2
7	Circular & Polynomial Arrangements 26. Circular: Facing Centre vs. Facing Outwards 27. Inward/Outward Mixed configurations 28. Square and Rectangular Table arrangements 29. Relationship-based seating (Combining Seating + Blood Relations)	2
8	Complex Puzzles 30. Grid/Matrix Puzzles (3 or 4 variables: Name, City, Profession, Color) 31. Scheduling Puzzles (Days of the week, Months, Years) 32. Floor-based Puzzles 33. Box-based Puzzles (Stacking logic)	2
9	Syllogisms 34. Standard Propositions (All, Some, No, Some Not) 35. Venn Diagram Method 36. "Only a Few" and "Few" cases 37. Possibility-based conclusions 38. Complementary pairs (Either-Or cases)	2
10	Blood Relations & Direction Sense 39. Family Tree Construction (Standard symbols) 40. Coded Blood Relations 41. Direction Compass and Degree Turns	
Total Hours		20
Text Books		

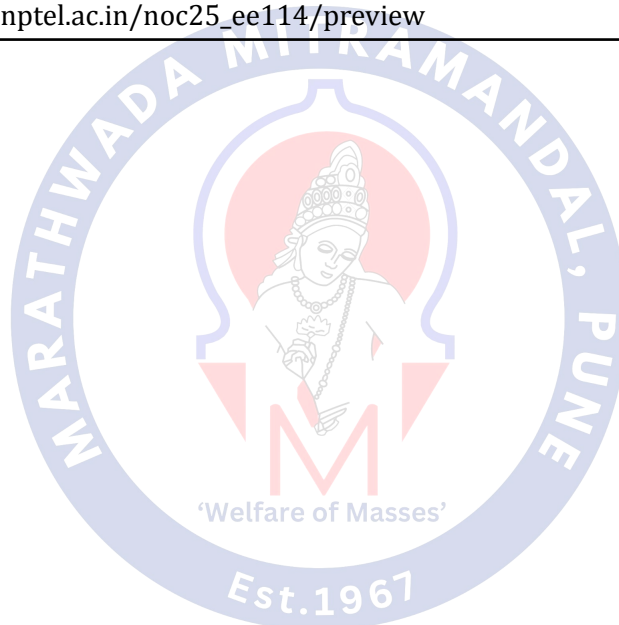
- | |
|--|
| <ol style="list-style-type: none">1. R. S. Aggarwal, "Quantitative Aptitude", S. Chand Publishing, New Delhi.2. M. Tyra, "Speed Mathematics", BSC Publishing, New Delhi.3. K. Kundan, "Logical Reasoning", Arihant Publications, New Delhi. |
| <ol style="list-style-type: none">4. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning (Puzzles), S. Chand Publishing, New Delhi.5. M. K. Pandey, Analytical Reasoning and Critical Thinking, Arihant Publications, New Delhi.6. A. Sharma, Data Interpretation and Logical Reasoning (Advanced Level), McGraw-Hill Education, New Delhi. |





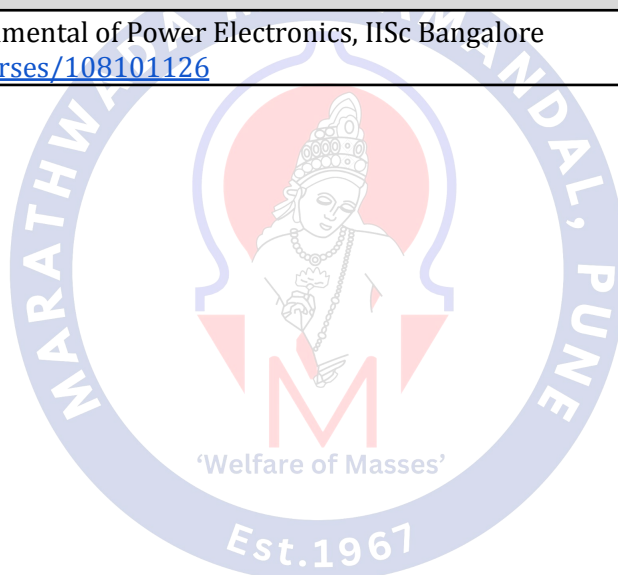
Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PCC351					Course Name: Advanced Communication									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Analog and Digital Communication Systems														
Course Objectives:														
• To interpret various random processes and noise. • To interpret the baseband and passband communication system. • To develop a comprehensive understanding of spread spectrum modulation. • To interpret different source coding techniques.														
Course Outcomes:														
After completing the course, the students will be able to:														
CO1: Analyze baseband and passband communication system.														
CO2: Apply the Spread Spectrum Modulation to specific communication scenarios.														
CO3: Interpret mathematical techniques for source coding of diversified types of discrete data.														
CO4: Illustrate error control coding techniques to improve performance of a digital communication system.														
Unit	Contents													Hrs
1	Digital Modulation-I Baseband Signal Receiver: Probability of Error, Optimal Receiver Design. Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).													9
2	Digital Modulation-II Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Interchannel and Intersymbol Interference, Comparison of digital modulation systems.													9
3	Spread Spectrum Modulation Use of Spread Spectrum , Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum , Frequency Hopping (FH) Spread Spectrum, Pseudorandom (PN) Sequences: Generation and Characteristics, Orthogonal Frequency Division Multiplexing (OFDM)													7
4	Information Theoretic Approach to Communication System Introduction to information theory, Entropy and its properties, Source coding theorem, Prefix coding, Shannon's limit, Huffman coding, Shannon-Fano coding, Lampel Ziv, Discrete memory less channel, Mutual information, Channel capacity, Channel coding theorem, Information Capacity theorem.													8
5	Error-Control Coding Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Cyclic codes, Hamming codes, Galva field, BCH,RS													8
													Total Hours	41

Text Books	
1. Bernard Sklar and Pabitra Kumar Ray, "Digital Communications: Fundamentals and Applications", Pearson Education Asia, Second Edition, Nov 2008. 2. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", (Fourth edition), Oxford University Press, Jan 2011.	
Reference Book	
1. John G. Proakis and Masoud Salehi, "Digital Communications", Tata McGraw Hill, Fifth Edition, 2014. 2. Simon Haykin, "Digital Communications", John Wiley and Sons, April 2013.	
Online References	
1. Principles of Digital Communication, NPTEL https://onlinecourses.nptel.ac.in/noc26_ee25/preview 2. Spread Spectrum Communications And Jamming, NPTEL https://onlinecourses.nptel.ac.in/noc26_ee60/preview 3. An Introduction to Coding Theory, NPTEL https://onlinecourses.nptel.ac.in/noc25_ee114/preview	



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PCC352					Course Name: Power Electronics and Applications									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Basic Electronics, Analog Electronics														
Course Objectives: - To understand the structure, operation, and characteristics of various power semiconductor devices. - To study and design driver circuits for power devices. - To analyze the principles and performance parameters of phase-controlled rectifiers with various loads. - To understand the operation and performance of DC to DC converters. - To study the principles, performance parameters and control strategies of DC to AC converters.														
Course Outcomes: After completing the course, the students will be able to: CO1: Examine the characteristic parameters of modern power devices. CO2: Interpret triggering / driver circuits for various power devices. CO3: Analyze the performance of phase controlled rectifiers. CO4: Understand the performance of isolated and non isolated type DC to DC converters. CO5: Elaborate the working principle of inverters and its power factor correction.														
Unit	Contents													Hrs
1	Power Semiconductor Devices Scope & applications, Requirements of ideal switching devices, Classification, Construction, Characteristics & applications of Power diodes, Schottky diode, Fast recovery diode, SCR, Power transistor, Power MOSFET, IGBT and GTO, New semiconductor material.													8
2	Driver Circuits & AC voltage Controllers Drive circuits for SCR, Power transistor, Power MOSFET, IGBT and GTO, Practical triggering circuits. AC voltage controllers: Principle of operation, single phase AC voltage Controllers, performance analysis of AC voltage controller.													7
3	Phase Controlled Rectifiers Principle of Phase control, Rectifier with R, R-L, FWD, Full wave controlled rectifier: Bridge, Semiconverter symmetrical & asymmetrical type controlled rectifiers, performance parameters, Numericals. Three phase power converters: Circuit diagram, waveforms and output voltage equation.													9
4	Choppers Principle of chopper operation: Circuit diagram, waveforms, output voltage equation, Control strategies, Step up chopper: Circuit diagram, waveforms, output voltage equation, Four quadrant based chopper circuits. DC to DC converters without isolation: Buck, Boost, Buck-Boost, DC to DC converters with isolation: Flyback, Forward, push pull converter.													8
5	Inverters													7

	Principle of operation, Performance parameters, Single phase IGBT based bridge inverter, Three phase bridge inverter, Effect of poor power factor, Method of reactive power compensation, Concept of static VAR compensators. Simulation of Power Electronics applications: Simulink/Spice/PSIM/ any suitable/case study of UPS.	
Total Hours		39
Text Books		
1. M. S. Jamil Asghar, <i>Power Electronics</i>, 4th edition. New Delhi, India: Prentice Hall of India, 2014.. 2. P. S. Bimbhra <i>Power Electronics</i> 4th edition, Khanna Publishers, 2012. 3. Muhammad H. Rashid, <i>Power Electronics Circuits, devices, and applications</i>, 3rd edition, Prentice Hall of India, 2005. 4. K. Hari Babu, <i>Power Electronics</i>, 4th edition, Scitech, 2015.		
Reference Book		
1. M. Singh and K. Khanchandani, <i>Power Electronics</i>, 2nd edition, 2015. 2. P. C. Sen, <i>Modern Power Electronics</i>, 2nd edition July 1, 2008. 3. Ned Mohan <i>et.al.</i>, <i>Power electronics converters and Design</i>, 3rd edition, 2015.		
Online References		
1. Prof. L.Umanand, Fundamental of Power Electronics, IISc Bangalore https://nptel.ac.in/courses/108101126		



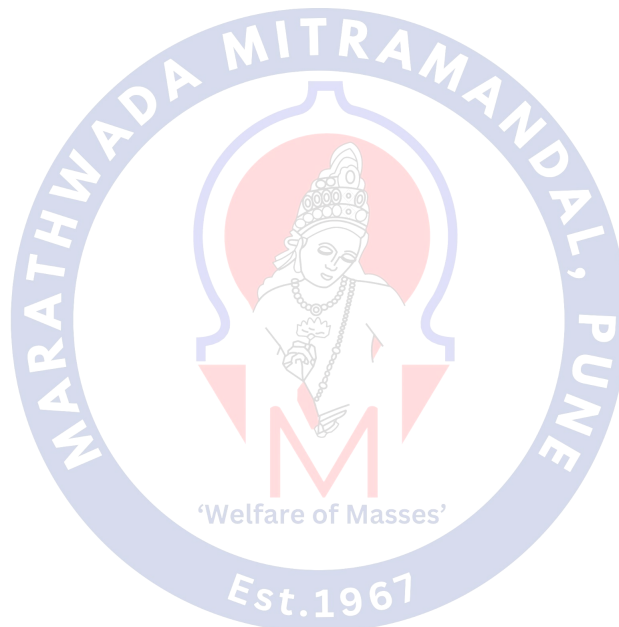
Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PCC353					Course Name: Real-Time Operating Systems									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: C Programming Language, Operating Systems, Basic Computer Architecture														
Course Objectives: - To introduce the QNX real-time operating system architecture and the Momentics development environment. - To develop skills in process, thread, and synchronization programming on QNX. - To explain interprocess communication mechanisms and message passing in QNX. - To enable programming of timers, hardware I/O, and interrupt handling. - To illustrate the design of resource managers and building of a bootable QNX system image. Course Outcomes: After completing the course, the students will be able to: CO1: Interpret the QNX architecture and use the Momentics environment to build, run, and debug applications. CO2: Apply process, thread, and synchronization concepts to write concurrent programs in QNX. CO3: Apply interprocess communication and message passing techniques in QNX applications. CO4: Apply timing, hardware I/O, and interrupt programming concepts on QNX. CO5: Design resource managers and build a bootable QNX system image.														
Unit	Contents													Hrs
1	Foundations of QNX & Development Environment: Introduction to the QNX real-time operating system and its architecture. Momentics development basics and the Eclipse-based IDE. Introduction to security policies. Working with the Eclipse environment: Eclipse basics, targets, projects and source. Compiling applications, running and debugging programs. Managing versions.													8
2	Processes, Threads & Synchronization: Processes and threads in QNX. Creating and managing processes. Working with threads. Process termination and cleanup. Synchronization primitives and techniques for coordinating concurrent execution.													8
3	Interprocess Communication (IPC): Message passing fundamentals. Designing a message passing system. Pulses and the client information structure. How a client finds a server. Multi-part messages. Issues related to priorities. Event delivery and shared memory. Comparison of IPC methods.													8
4	Time & Hardware Programming: Timing architecture in QNX. Getting and setting the system clock. Timers and high-resolution timers. Design considerations and kernel timeouts. Introduction to hardware programming: hardware I/O, programming PCI bus devices, and handling interrupts.													8
5	Resource Managers & System Integration: Introduction to resource managers: overview and architecture. Building a simple resource manager: initialization and handling read() and write() requests. Building a boot image to assemble and deploy a complete QNX system.													7
Total Hours														39
Text Books														

1. Robert Krten, "Getting Started with QNX Neutrino: A Guide for Realtime Programmers", PARSE Software Devices.
2. QNX Software Systems, "QNX Neutrino RTOS – System Architecture", QNX Software Systems.
3. QNX Software Systems, "QNX Momentics IDE User's Guide", QNX Software Systems.

Reference Book

1. QNX Software Systems, "QNX Neutrino RTOS – Programmer's Guide", QNX Software Systems.
2. QNX Software Systems, "Building Embedded Systems", QNX Software Systems.

Online References



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PEC354A					Course Name: Industrial Automation (Elective 2)									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: C++, Digital Circuits, Sensors and Applications														
Course Objectives: • To introduce the fundamentals of industrial automation and the architecture of Programmable Logic Controllers (PLC). • To develop understanding of PLC hardware, I/O modules, field devices, and selection criteria for industrial applications. • To impart knowledge of PLC programming languages and techniques using Ladder Logic and Structured Text. • To familiarize students with SCADA systems, industrial communication protocols, and emerging trends such as AI-enabled and cloud-based PLC. • To provide basic understanding of industrial robotics, robot programming, and integration of robots with PLC-based automation systems. Course Outcomes: After completing the course, the students will be able to: CO1: Illustrate the role of industrial automation and describe PLC architecture, types, and applications. CO2: Identify and select appropriate PLC hardware, I/O modules, and field devices for given industrial control requirements. CO3: Analyze PLC programs using Ladder Diagram and Structured Text for basic automation problems. CO4: Illustrate the working of SCADA systems, industrial communication protocols, and cloud-enabled PLC concepts. CO5: Describe industrial robot configurations, basic robot programming methods, and PLC-robot integration in automation systems.														
Unit	Contents													Hrs
1	Introduction to PLC and Industrial Automation: Role, benefits, and necessity of industrial automation. History, evolution, and NEMA definition of PLC. Types of PLCs: fixed, modular, and dedicated. Basic PLC architecture: CPU, I/O modules with interfacing, power supply, programming, and monitoring devices. PLC selection criteria, specifications, advantages, and limitations. Brief comparison of major PLC manufacturers Automation hierarchy, types of automation systems.													8
2	PLC Architecture and I/O Modules: PLC architecture, CPU functions, scanning cycle, execution speed, operating modes, and PLC memory organization. Input and Output modules: discrete and analog types. Discrete I/O modules—block diagram, functions, specifications, and wiring. Analog I/O modules—block diagram, functions, specifications, and wiring. Comparison of AC and DC discrete PLC modules. Sinking and sourcing concepts of I/O modules and PLC selection criteria.													8
3	PLC Programming: PLC programming languages as per IEC 61131-3: Ladder Diagram (LD), Functional Block Diagram (FBD), Sequential Function Chart (SFC), Structured Text (ST), and Instruction List (IL) – introduction and features. Ladder diagram fundamentals, rules for proper ladder construction, and ladder logic structure. PLC I/O addressing. Structured Text (ST) Programming: Basic syntax, data types, conditional statements, loops, and implementation of simple control applications.													8

4	SCADA, Industrial Communication & Emerging Trends: Supervisory Control and Data Acquisition (SCADA): basic functions, generalized block diagram and functions of each block, interfacing of SCADA with PLC, and industrial applications of SCADA. Industrial communication systems: communication interfaces and commonly used protocols such as MODBUS (RTU and TCP/IP), Ethernet/IP, FOUNDATION Fieldbus. AI tools for PLC programming: introduction, benefits, applications, and challenges of integrating AI in PLC-based automation systems. Cloud PLC: concept of cloud-enabled PLC. Insight of Automation Studio Software, Introduction to mapp Technology.	8
5	Robotics and Industrial Automation: Introduction to industrial robotics and role of robots in automation. Basic components of a robotic system: manipulator, controller, drive system, sensors, end-effectors, and power supply. Robot coordinate system, Robot programming methods. Integration of robots with PLC and industrial networks. Applications of robots in industrial automation. Safety standards and precautions in robotic automation.	8
Total Hours		40
Text Books		
1. Frank D. Petruzella. Programmable Logic Controllers, 4th ed., McGraw-Hill Education, 2011. 2. Gary Dunning. Programmable Logic Controllers: An Operational Approach, Delmar Cengage Learning, 2010. 3. John W. Webb and Ronald A. Reis. Programmable Logic Controllers: Principles and Applications, 5th ed., Prentice Hall, 2008. 4. Stuart A. Boyer. SCADA: Supervisory Control and Data Acquisition, 4th ed., ISA Publications, 2010. 5. Mikell P. Groover. Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd ed., Pearson Education, 2008.		
Reference Book		
1. John R. Hackworth and Frederick D. Hackworth. Programmable Logic Controllers: Programming Methods and Applications, Pearson Education, 2004. 2. Karl-Heinz John and Michael Tiegelkamp. IEC 61131-3: Programming Industrial Automation Systems, Springer, 2010.		
Online References		
1. NPTEL Course on "Programmable Logic Controllers and Industrial Automation", by Prof. S. Mukhopadhyay, Prof. S. Sen e, https://nptel.ac.in/courses/108105063		

Est. 1967

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PEC354B					Course Name: Computer Vision (Elective 2)									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Signals and Systems, Basics of programming Language, Object oriented programming														
Course Objectives: - Introduce the fundamental concepts and applications of computer vision. - To introduce fundamental image processing, enhancement, segmentation, and feature extraction techniques. - Familiarize students with machine learning and deep learning techniques used in computer vision. - Enable students to design and implement basic computer vision solutions for real-world applications. Course Outcomes: After completing the course, the students will be able to: CO1: Understand fundamentals of computer vision, image formation, and digital image representation. CO2: Apply image processing techniques for enhancement, filtering, segmentation, and feature extraction. CO3: Understand computer vision frameworks for application development. CO4: Apply machine learning and deep learning algorithms for computer vision. CO5: Design and develop computer vision applications for real-world problems.														
Unit	Contents													Hrs
1	Basics of Computer Vision Introduction to image processing, Digital image representation, Basics of linear algebra and probability for vision, Python-based CV ecosystems-NumPy, SciPy, scikit-image. Image formation and camera models. Introduction to video representation (frames, frame rate, temporal sampling). Introduction to computer vision, Human vision vs computer vision.													8
2	Image Processing Foundation and Feature Extraction Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture. Image enhancement techniques, Spatial filtering and edge detection, Image segmentation methods, Morphological operations, Feature detection and description-SIFT, SURF.													7
3	Computer Vision Framework Camera and Image Formation Frameworks, Camera geometry and imaging models, Camera calibration techniques, Projection models and coordinate transformations, Motion Estimation and Optical Flow Frameworks, introduction to motion analysis in vision. Software Frameworks for Computer Vision OpenCV for image processing and classical vision algorithms, Deep learning frameworks for vision-TensorFlow, PyTorch, Keras													8
4	Machine Learning for Computer Vision Role of machine learning in computer vision, Supervised and unsupervised learning, Feature-based learning approaches, Introduction to neural networks, Convolutional Neural Networks, Recurrent NN, Transfer learning for vision tasks.													9
5	Object Detection, Recognition, and Applications Object detection and recognition techniques, Face detection and recognition, Surveillance – foreground-background separation, tracking, and occlusion – combining views from multiple													7

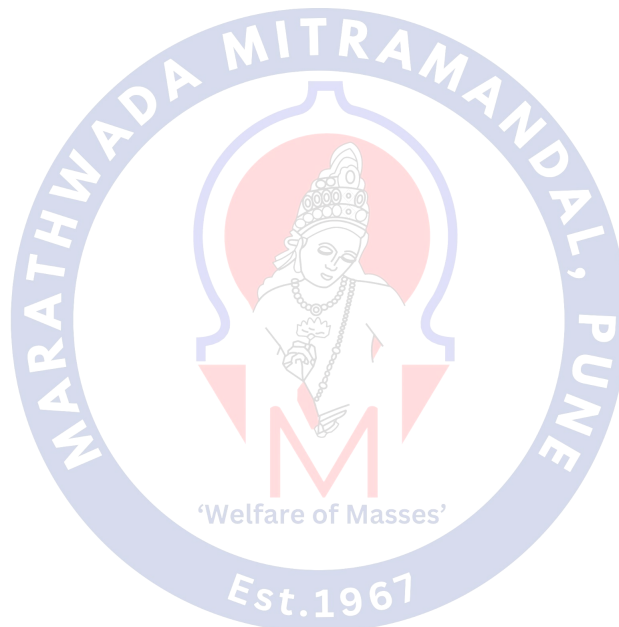
cameras. Deep learning-based detectors-YOLO/SSD/FasterR-CNN-overview, Semantic segmentation, Applications: medical imaging, autonomous vehicles, surveillance, AR/VR.	
Total Hours	39
Text Books	
1. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow – Aurélien Géron, O'Reilly Media, 2nd Edition, 2019. 2. Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer, 1st Edition, 2006. 3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022. 4. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.	
Reference Book	
1. The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2nd Edition, 2009. 2. Introduction to Machine Learning – Ethem Alpaydin, MIT Press, 3rd Edition, 2014. 3. Machine Learning – Tom M. Mitchell, McGraw-Hill, 1st Edition, 1997. 4. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004. 5. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006. 6. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.	
Online References	
1. Computer Vision videos (NPTELPrep entry) – NOC: Computer Vision and Image Processing Videos https://www.nptelprep.in/courses/106105216/videos 2. Computer Vision and Image Processing: https://nptel.ac.in/courses/108103174 3. Deep Learning for Computer Vision videos – NOC: Deep Learning for Computer Vision https://www.nptelprep.in/courses/106106224/materials 4. Machine Learning videos – NOC: Machine Learning, ML https://www.nptelprep.in/courses/106106202/materials	

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PEC354C					Course Name: CMOS Digital VLSI Design (Elective 2)									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Fundamentals of Digital Electronics, Basic Electronic Devices and Circuits, VLSI Design														
Course Objectives: - To provide knowledge of circuit models for analysis of digital CMOS circuits. - To explain layout design to realize CMOS circuits - To explain fundamentals of low power design techniques														
Course Outcomes: After completion of the course, students will be able to CO1: Explain the fundamentals of MOS and CMOS based logic circuits. CO2: Analyze the performance parameter of CMOS logic circuit. CO3: Design CMOS combinational logic circuits CO4: Explain the concepts of semiconductor memories CO5: Describe the fundamentals of low power design techniques														
Unit	Contents													Hrs
1	Unit I: Fundamentals of CMOS Logic Types and principles of MOSFETs. CMOS inverter, Voltage Transfer Characteristics(VTC),logic threshold, Noise margins. Second order effects in MOSFETs. Dynamic behaviour, transition time, Propagation Delay, Power Consumption.													8
2	Unit II: CMOS Layout Fundamentals Technology scaling, MOS Circuit layout, Stick diagrams, Layout design rules, MOS device layout,Inverter layout, CMOS-circuits layout.													8
3	Unit III:CMOS Logic Design Combinational MOS Logic Design, Static MOS design, Complementary MOS, Ratioed logic, PassTransistor logic, Transmission gate logic and circuits,CMOS latch,D flip flop & registers,Sequential MOS Logic Design													8
4	Unit IV: Semiconductor Memories Introduction, Classification of Semiconductor Memories, Design of ROM, SRAM and DRAM cells and memory architecture, Non Volatile Memory													8
5	Unit-5 Low power CMOS logic Circuits Standard cell based design, fundamentals of low power design techniques: clock gating, power gating, voltage scaling etc.,Case study on low power design													8
Total Hours													40	
Text Books														
1. S.M. Kang & Y. Leblibici, “CMOS Digital Integrated Circuits-Analysis & Design”, McGraw-Hill, (3rd edition), (2003). 2. Jan M. Rabaey, Anantha P.Chandrakasan, BorivojeNikolić, “Digital Integrated Circuits: A Design Perspective”, Pearson Education, (2nd Edition), (2003).														
Reference Book														
1. Neil Weste& K. Eshraghian,“Principles of CMOS VLSI Design: A Systems Perspective”, McGraw Hill Pub., (1985).														

2. Douglas Pucknell, Kamran Eshraghian, "Basic VLSI Design", PHI., (3rd Edition), (2013).

Online References

1. CMOS Digital VLSI Design - Course :https://onlinecourses-archive.nptel.ac.in/noc19_ee25/preview

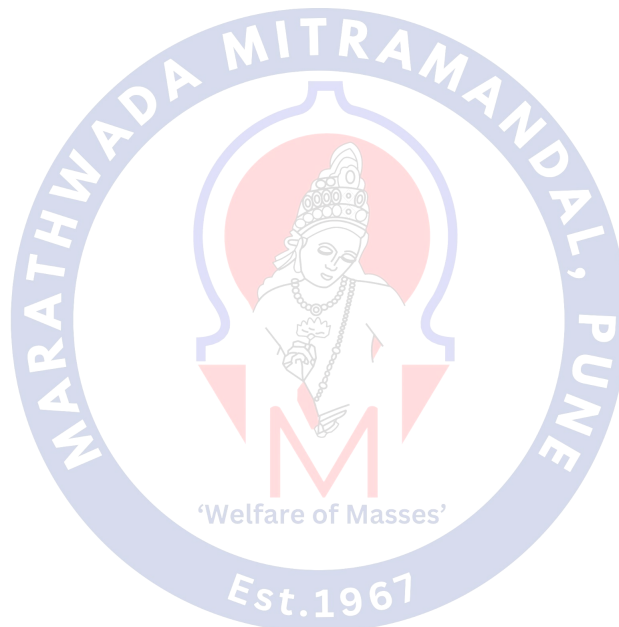


Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PEC354D					Course Name: Electromagnetics and Wave Propagation									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3
Prerequisite: Mathematics I and II, Analog and Digital Communication Systems														
Course Objectives: - Determine the fundamental principles and equations of static electric and magnetic fields by using vector calculus and coordinate systems. - Understand Maxwell's equations and boundary conditions governing electric and magnetic fields. - Identify time-varying electromagnetic fields. - Determine transmission line behavior and wave propagation characteristics. - Introduction to the theory of radiation. Course Outcomes: After completing the course, the students will be able to: CO1: Analyze static electric and magnetic fields using vector calculus, Gauss's law, Biot-Savart law, and Ampere's circuital law. CO2: Understand Maxwell's equations and boundary conditions to analyze electromagnetic fields in different media. CO3: Analyze time-varying electromagnetic fields and Maxwell's equations. CO4: Analyze transmission lines and uniform plane wave propagation . CO5: Understand the fundamentals and performance parameters of the antenna.														
Unit	Contents													Hrs
1	Static Electric and Magnetic Field Review of 3D Coordinate systems, Vector Calculus, Gradient, Divergence, Curl; Electric field intensity (E), Electric Flux Density (D), Gauss's law, Electric potential (V), Potential Gradient, E/D/V due to point charge; Current Density, Magnetic Field Intensity (H), Magnetic Flux Density (B), Biot-Savart's Law, Ampere's Circuital Law, Magnetic Field Intensity due to straight conductors.													10
2	Maxwell's Equations For Static Field and Boundary Conditions Maxwell's Equations for Static Electric and Static Magnetic fields; Boundary conditions for Electric Field (dielectric-dielectric, conductor –dielectric); Boundary conditions for Magnetic Field; Poisson's and Laplace's equation.													8
3	Time Varying Fields Faraday's law, Translational and Motional EMF, Displacement current density; Time varying Maxwell's equations - point form, integral form; Poynting Theorem.													7
4	Transmission Lines and Uniform Plane Waves Maxwell's equations in phasor form, Electromagnetic wave equation (Helmholtz equation); Skin Depth; Transmission line parameters, Propagation Constant, Characteristic Impedance, Reflection Coefficient, VSWR; Transmission line equation for lossless and distortionless line; EMI and EMC; Smith Chart and applications.													8

5	Introduction to Antenna Fundamental equation for free space propagation; Introduction to antenna, Radiation Mechanism, Classifications; Antenna Performance Parameters: Return Loss, Gain, Directivity, Efficiency, Radiation Pattern, Radiation Power Density, Radiation Intensity.	6
Total Hours		39
Text Books		
1. M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press, India, 2015 (Asian adaptation of 'M.N.O. Sadiku, Elements of Electromagnetics, Sixth International Edition, Oxford University Press'), 6th Edition. 2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, 8th Revised Edition. 3. C.A. Balanis — "Antenna Theory - Analysis and Design", Fourth Edition, John Wiley Publication Wiley.		
Reference Book		
1. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5th Edition. 2. Jordan and Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1964. 3. K. D. Prasad, "Antenna & Wave Propagation" Satya Prakashan, New Delhi. 4. J. D. Ryder, "Network, Lines and Fields", PHI.		
Online References		
1. NPTEL Course on "Electromagnetic theory - Video course" by Dr. Pradeep Kumar, IIT Kanpur. Link of the Course: https://onlinecourses.nptel.ac.in/noc21_ee83/preview 2. NPTEL Course on "Transmission lines and electromagnetic waves" by Prof. Ananth Krishnan, IIT, Madras. Link of the Courses: nptel.ac.in/courses/108106157		

Third Year B. Tech Electronics and Telecommunication Engineering															
Semester VI															
Course Code: ET24MDM355					Course Name: Applications of Embedded Systems										
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	ODL	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	-	3
Prerequisite: C language, Digital Electronics															
Course Objectives: • To discuss the fundamentals of embedded systems. • To learn applications of embedded systems in consumer, industrial, automotive, and healthcare domains. • To gain knowledge of embedded IoT systems, wireless communication, and cloud connectivity. • To introduce emerging trends in embedded technologies. Course Outcomes: After completing the course, the students will be able to: CO1: Discuss the fundamentals of embedded systems, their architecture, and components. CO2: Apply embedded systems in consumer, industrial, and healthcare applications. CO3: Discuss automotive embedded applications, including ECU, ADAS, and safety-critical systems. CO4: Apply IoT-based embedded system concepts, including wireless modules and cloud protocols.															
Unit	Contents														Hrs
1	Introduction to Embedded System Applications: Review of embedded system components, Role of embedded systems in automation and intelligent systems, Categories of embedded applications: standalone, real-time, networked, mobile, Embedded development platforms overview.														8
2	Embedded Systems in Consumer and Industrial Applications: Consumer electronics: Smart TVs, appliances, wearables, Industrial applications: Process automation, PLCs, SCADA, Robotics: Motor control, sensor integration, feedback systems, Real-time control systems and safety-critical applications.														8
3	Embedded Systems in Automotive: Automotive electronics: ECU, ADAS, Vehicle to vehicle communication, Embedded safety features: airbags, ABS, engine control, Embedded software validation in safety-critical domains.														8
4	Embedded IoT Applications: Embedded systems in IoT: Concepts, architecture, and protocols, Wireless modules: Wi-Fi, Bluetooth, LoRa, Cloud connectivity: Basics of MQTT, HTTP, and REST APIs.														8
5	Embedded Systems in Healthcare: Wearables: Fitness bands, smartwatches with health tracking, Patient Monitoring Systems: Vital sign monitors, ICU bedside systems, Implantable Devices: Pacemakers, insulin pumps, Telemedicine Devices: Remote diagnostics, smart stethoscopes.														7
Total Hours															39

Text Books	
1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edition, McGraw-Hill Education, 2017. 2. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, 2nd Edition, Wiley, 2010.	
Reference Book	
1. Shibu K. V., Introduction to Embedded Systems, 2nd Edition, McGraw-Hill, 2017. 2. David E. Simon, An Embedded Software Primer, 2nd Edition, Pearson, 2009. 3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 5th Edition, Springer, 2016.	
Online References	
1. NPTEL Course: Prof. Dhananjay V. Gadre & Prof. Badri Subudhi, Netaji Subhas University of Technology and IIT Jammu, "Introduction to Embedded System Design - Video Course" [https://nptel.ac.in/courses/108102169/]	



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24PCC356					Course Name: Advanced Communication Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1
Prerequisite: Analog and Digital Communication Systems, Signals and Systems														
Course Objectives: • To analyze various modulation techniques for digital communication systems. • To apply spread spectrum modulation technique to transmit and receive the signal. • To apply error control coding techniques in digital communication. • To analyze the random process using statistical parameters.														
Course Outcomes: After completing the course, the students will be able to: CO1: Analyze digital communication systems using various modulation techniques. CO2: Illustrate spread spectrum modulation for the digital message signal. CO3: Analyze error control coding techniques for information signals.														
List of Tutorials														
Unit	Contents													Hrs
Hardware Practicals														
1.	Generation and reception of BPSK/BFSK using suitable hardware setup/kit.													4
2.	Generation and reception of QPSK using suitable hardware setup/kit.													4
3.	Study of Error Control Coding using suitable hardware setup/kit.													2
4.	Generation and reception of DSSS using suitable hardware setup/kit.													4
Software Practicals														
5.	Simulation study of Performance of M-ary QAM.													2
6.	Simulation study of Source Coding technique.													2
7.	Simulation Study of Linear Block codes.													2
8.	Simulation Study of cyclic codes.													2
Mini project/Case Study/ Survey: (Any One)														
9.	Mini project using Digital modulation/ Spread Spectrum techniques.													4
	Case study on Information theory and Coding.													4
	Compliance standards for digital communication.													4
													Total Hours	26
Text Books														
1. Bernard Sklar and Pabitra Kumar Ray, "Digital Communications: Fundamentals and Applications", Pearson Education Asia, Second Edition, Nov 2008.														

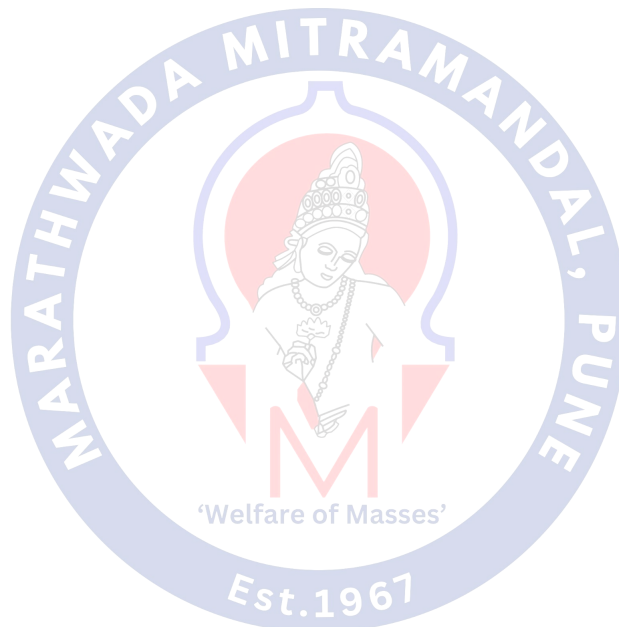
2. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems"(Fourth edition), Oxford University Press, Jan 2011.

Reference Book

5. John G. Proakis and Masoud Salehi, "Digital Communications", Tata McGraw Hill, Fifth Edition, 2014.
6. Simon Haykin, "Digital Communications", John Wiley and Sons, April 2013.

Online References

1. Analyse data compaction by Shift Keying Techniques - ASK, FSK, BPSK & QPSK
2. Data security using Direct Sequence Spread Spectrum (DS-SS).
3. Error detection and correction of Linear Block Codes: Encoder and Decoder.



Third Year B. Tech Electronics and Telecommunication Engineering														
Semester V														
Course Code: ET24PCC357					Course Name: Power Electronics and Applications Lab									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1
Prerequisite: Basic Electronics, Analog Electronics														
Course Objectives: - To understand the operating characteristics, parameters of power semiconductor devices such as SCR, MOSFET, and IGBT. - To study the functioning of rectifiers, inverters, choppers, and AC voltage controllers through practical waveform observation and measurement. - To develop the ability to measure, analyze, and interpret key performance parameters such as threshold voltage, duty cycle, RMS voltage, and regulation. - To gain proficiency in using laboratory instruments and simulation tools for evaluating power electronic circuits. - To apply power electronics principles to real-world applications. Course Outcomes: CO1: Plot V-I characteristics of power devices and compare results with datasheet specifications. CO2: Implement the driver circuits for various power devices. CO3: Verify the performance of controlled rectifiers. CO4: Examine the performance of DC to DC converters. CO5: Elaborate working principle of DC to AC Converters.														
Unit	Contents													Hrs
1	VI Characteristics of SCR i) Plot output V-I characteristics to measure I_H , I_L and voltage before and after breakdown , ii) Observe the effect of gate current on forward break down iii) gate characteristics iv) compare with datasheet specifications													2
2	V-I Characteristics of Power MOSFET i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications													2
3	V-I Characteristics of IGBT i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications													2
	Any Four Experiments From 4 to 8													
4	Step down / Step up chopper using power MOSFET / IGBT i) Measure duty cycle and observe effect on average load voltage for DC chopper.													2
5	Single phase Full Converter using IGBT / SCR with R & R-L load i) Observe load voltage waveform, ii) Measurement of average o/p voltage across loads, iii) Verification of theoretical values with practically measured values.													2
6	Single-Phase PWM Power MOSFET / IGBT based bridge inverter for R and motor load i) Observe output voltage waveforms and measure set of rms output voltage for varying pulse width and													2

	variable input dc voltage for R and motor load, ii) compare measured output voltages with the theoretical findings.	
7	SMPS /UPS Performance Evaluation i) find load & line regulation characteristics with and without load. ii) Study the supplier specifications.	2
8	Single phase AC voltage controller using IGBT/SCR for R and RL load i) Observe output rms voltage waveforms, ii) Measurement output voltage across load Or Simulation of the Single phase AC voltage controller using any open source circuit simulation software.	2
9	To study speed control of DC / single phase AC motors. (Trainer panel/Vlab)	2
10	To study performance parameters of Solar Panel.	4
11	Industrial visit to any Renewable Energy Power Plant/Self -Paced online Power Electronics course (Simulink/Coursera/Udemy)	6
Total Hours		26
Text Books		
1. K. Hari Babu, "Power electronics", 4th edition ,Scitech, 2015. 2. S. K. Bhattacharya, "Fundamentals of Power Electronics", McGraw-Hill Education, 2023.		
Reference Book		
1. Muhammad H. Rashid, "Power electronics Circuits, devices, and applications", 3rd edition, Prentice Hall of India, 2005.		
Online References		
1. Power Electronics VLAB: https://pe-iitr.vlabs.ac.in/exp/bipolar-transistor/ 2. Power Electronics VLAB: https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html 3. Power Electronics Simulation Onramp, Self-Paced Online Course by Alisha Schor, Mathworks. https://matlabacademy.mathworks.com/details/power-electronics-simulation-onramp/powerelectronics		

Third Year B. Tech Electronics and Telecommunication Engineering															
Semester VI															
Course Code:ET24PCC358								Course Name: Engineering Design and Innovation-II							
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL	
-	2	-	-	-	-	-	25	-	-	25	-	1	-	1	
Prerequisite:															
Course Objectives: - To identify and define real-world engineering problems with societal relevance. - To apply design thinking and engineering principles to propose innovative solutions using appropriate engineering tools. - To explore interdisciplinary approaches in problem solving. - To develop teamwork, communication, and project management skills. - To Create working models, prototypes, or validated design solutions considering sustainability and ethics.															
Course Outcomes: After completing the course, the students will be able to: CO1: Identify and analyze real-world engineering problems using systematic design approaches. CO2: Conduct literature survey and benchmark existing solutions using appropriate tools. CO3: Design innovative engineering solutions considering technical, economic, social, and environmental constraints. CO4: Develop and demonstrate prototypes/models or validated design outcomes as a team member or leader. CO5: Document and communicate the design process effectively through reports and presentations.															
Group A: Project															
Course Philosophy: Engineering Design and Innovation-I emphasize design-driven project development supported by appropriate engineering tools, platforms, and methodologies. Students are expected to progress from problem identification to validated implementation, using discipline-aligned tools and experimental practices wherever applicable. The course facilitates early-stage design readiness, enabling students to translate concepts into realizable solutions through guided hands-on exploration and project execution.															
Design Readiness & Skill Development: As part of Engineering Design and Innovation-I, students shall acquire and demonstrate proficiency in one selected engineering skill group relevant to their project domain. Each project group shall select ONE Skill Group aligned with their problem domain. The selected skill group shall: - Support design, simulation, implementation, or validation - Be integrated with the project, not treated as a separate lab Each project group must <i>demonstrate competency in at least one engineering skill domain</i> through hands-on implementation as part of the project lifecycle.															
Project Execution: Students will perform following activities: Problem identification aligned with core engineering domains / societal needs															

2. Team formation (4–5 students per group)
3. Literature review (research papers, patents, products, standards)
4. Development of System architecture and block diagrams
5. Design calculations, simulations, or modeling
6. Consideration of risk, sustainability, and ethical aspects
7. Hardware / software implementation or prototype development
8. Technical report preparation
9. Design presentation and demonstration
10. Exploration of scope for publication, patenting, or participation in competitions

Group B: PEC-2 Lab

Program Elective Courses	Tool-Based Implementation Tasks
A: Industrial Automation	1. To create a new PLC project, configure controller hardware, and establish field I/O connections. 2. To configure PLC components and develop basic ladder logic programs Structured Text (ST) programs for automation applications. 3. To verify AND, OR, and NOT logic functions using push buttons and a lamp through PLC ladder logic. 4. To implement a PLC-based motor sequencing control system using Mapp Motion (Servo Motors) 5. To implement a PLC-based motor sequencing control system. 6. To design and implement a PLC-HMI based industrial control application using Mapp view-visualization 7. To implement PLC-robot cell I/O handshake with safety interlocks. 8. To implement Mapp Motion -single axis Configuration using MpAxis Basic function block (Homing , Velocity , Jog , Absolute Motion, Additive Motion)
B: Computer Vision	1. Study of Digital Image Representation 2. To perform edge detection and feature extraction on images. 3. To estimate motion between consecutive video frames. 4. To classify images using a CNN model. 5. To detect faces in images or video streams.
C: CMOS Digital VLSI Design	1. Introduction 2. Design, simulate and verify the operation of a CMOS inverter and explore measurement of power and delay. 3. Design, simulate and verify a 1 bit Full adder. 4. Design stick diagram layout for a 1 bit Full adder and capture and verify it in EDA tool. 5. Design transmission gate (TG) based D-FF - simulate and verify functionality and measure setup and hold time. 6. Design a 2-bit register with RD/WR using D-FFs - simulate and verify functionality. 7. Mini project : 2 bit ALU design/any other.
D: Advanced Java Programming	Any six: 1. Write a program to demonstrate the status of a key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown.

	2. Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. The frame should become visible when the mouse enters it. 3. Develop a GUI which accepts the information regarding the marks for all the subjects of a student in the examination. Display the result for a student in a separate window. 4. Write a program to insert and retrieve the data from the database using JDBC. 5. Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not. 6. Write a program with suitable examples to develop your remote interface, implement your RMI server, implement an application that creates your server, and also develop a security policy file. 7. Write a database application that uses any JDBC driver. 8. Write a simple JSP page to display a simple message (It may be a simple html page). 9. Create a simple calculator application using servlet. 10. Create login form and perform state management using Cookies, HttpSession and URL Rewriting. 11. Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and 12. Country from the user using HTML Form and store the registration details in the database.
Total Hours	13 x hours/ week= 26

Third Year B. Tech Electronics and Telecommunication Engineering														
Semester VI														
Course Code: ET24OEL359					Course Name: Leadership & Team Effectiveness (Open Elective)									
Teaching Scheme (Hours/Week)				Examination Scheme						Credits				
L	P	T	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	ODL	TOTAL
-	-	-	2	-	-	50	-	-	50	-	-	-	2	2
Prerequisite: Entrepreneurship Skills Development, Communication skills, Professional Communication and Personality Development														
Course Objectives: - To provide a framework for the students to understand the importance of Leadership and team effectiveness in organizations. - To develop an understanding of the interpersonal processes and group dynamics. - To provide a theoretical understanding of leadership practices in organizations. - To provide an understanding of factors influencing teamwork and team leadership. - To evaluate the role of leadership in the development of an institution. Course Outcomes: After completing the course, the students will be able to: CO1: Explain how global leadership skills contribute to leadership effectiveness. CO2: Understand the leader's role in team-based organizations. CO3: Explain the potential contribution of outdoor training to the development of team leadership. CO4: Explain the basics of leadership during a crisis. CO5: Explain how evidenced based leadership can contribute to contingency and situational leadership.														
Course Framework														
Common content related to course 1. Introduction to Leadership & Team Management; Leadership Myths; Interactional Framework for analyzing leadership; Leadership Development: The First 90 Days as a Leader; Leader Development- The Action-Observation-Reflection Model 2. LMX Theory and Normative Decision Model; Situational Leadership Model; Contingency Model and Path Goal Theory; Emotional Approach Charismatic and Transformational Leadership; Leadership for Tomorrow 3. Leadership Attributes; Personality Traits and Leadership; Personality Types and Leadership; Intelligence and Leadership; Emotional Intelligence and Leadership 4. Power and Leadership; The art of influence in leadership; Leadership and "Doing the Right Things; Character-Based Approach to Leadership; Role of Ethics and Values in Organisational Leadership 5. Leadership Behaviour; Leadership Pipeline; Assessing Leadership Behaviors: Multi-rater Feedback Instruments; The Dark Side of; Leadership- Destructive Leadership; Managerial Incompetence and Derailment Conflict Management 6. Negotiation and Leadership; Leadership under a crisis situation; The Situation and the Environment; Culture and Leadership; Global Leadership 7. Motivation and Leadership; Introduction to Groups and Teams; Characteristics of Leader, Follower and Situation; Group Dynamics; Team Formation 8. Delegation and Empowerment; Leading teams: Enhancing teamwork within a group; The leader's role in team-based organizations; Leader actions that foster Teamwork Effectiveness; Offsite training and team development 9. Understanding Team processes and Team Coaching; Team decision making and conflict management; Virtual teams; Managing Multicultural teams; Building great teams														

10. Experiential Learning; Action Learning; Development Planning; GAP Analysis; Coaching and Mentoring; Women in Leadership Roles
11. Building Effective Relationship with subordinates and peers; Fostering Followers satisfaction; The Art of Communication; Setting Goals and Providing Constructive Feedback; Enhancing Creativity problem solving skills
12. Building High-Performance Teams: The Rocket Model; Building Credibility and Trust; Skills for Developing Others; Team Building at the Top; Community Leadership

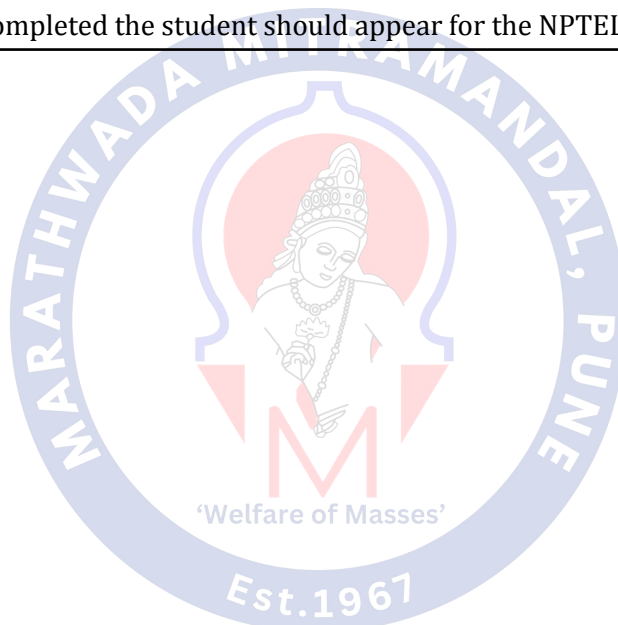
List of Online Course Available

Suggested list of NPTEL courses, not Limited to this:

1. https://onlinecourses.nptel.ac.in/noc25_mg38/preview
2. https://onlinecourses.nptel.ac.in/noc25_mg39/preview

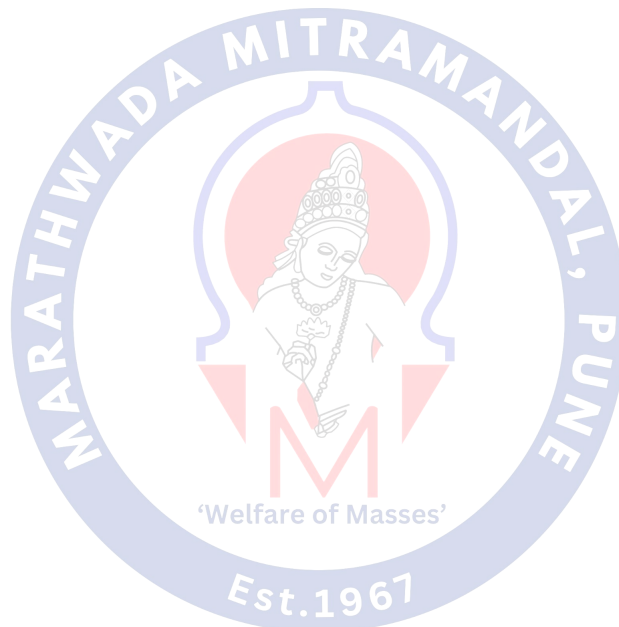
Guidelines for Conduction of Course

1. The student must register for the online course on the NPTEL .
2. The course duration should be at least 12 weeks or more.
3. Students should complete the online assignments, quizzes, projects, etc mentioned under the online course.
4. Once the course is completed the student should appear for the NPTEL course examination



Third Year B. Tech Electronics and Telecommunication Engineering															
Semester VI															
Course Code: ET24VSE360								Course Name: Internet of Things (VSE)							
Teaching Scheme (Hours/Week)					Examination Scheme						Credits				
L	P	T	OL	ODL	CIE	ETE	TW	PR	OR	TOTAL	L	P	T	ODL	TOTAL
-	4	-	-	-	-	-	50	-	-	50	-	2	-	-	2
Prerequisite: Microcontroller and Interfacing															
Course Objectives: • To introduce IoT development platforms and basic embedded programming. • To enable sensor-actuator interfacing and data acquisition. • To develop simple IoT applications with cloud and web integration. • To develop real-time IoT monitoring and automation systems using cloud dashboards and mobile applications Course Outcomes: After completing the course, the students will be able to: CO1: Interface sensors and actuators with IoT boards. CO2: Implement IoT communication using cloud, MQTT, and web server. CO3: Design basic IoT-based automation and monitoring systems. CO4: Develop cloud-connected IoT applications using dashboards, databases, mobile applications, and real-time visualization.															
Internet of Things - Group A															
Week	List of Practicals														Hrs
1	To study common IoT development platforms and set up a working environment to run a basic test program on a selected board.														2
2	To interface a DHT11/DHT22 sensor with an IoT development board and display temperature and humidity readings on the Serial Monitor / Terminal.														2
3	To interface NodeMCU / Raspberry Pi with a cloud-based MQTT broker and publish sensor data for real-time monitoring.														4
4	To demonstrate remote switching of lights ON/OFF using Arduino / NodeMCU / Raspberry Pi.														4
5	To write and execute an Arduino program to demonstrate hardware interrupts.														4
6	To interface a DHT11 sensor with Raspberry Pi (or equivalent) and upload/display temperature and humidity values on a web server using an HTML page.														4
7	To design an RFID-based attendance system using Arduino / NodeMCU / Raspberry Pi.														4
8	To design an IoT-based smart irrigation system with soil moisture sensing and cloud monitoring.														4
9	To interface an ESP32/NodeMCU with Firebase (or ThingSpeak/Blynk IoT Cloud) and upload real-time sensor data for remote monitoring.														4
10	To interface a camera module (ESP32-CAM or Raspberry Pi Camera) and implement image capture with remote monitoring over a web server.														4
11	To design an IoT-based Smart Home Automation System for controlling multiple appliances using a mobile application or web dashboard.														4
12	To interface an Ultrasonic Sensor (HC-SR04) with Raspberry Pi and monitor distance on a web dashboard.														4
13	To interface an MQ-2/MQ-135 Gas Sensor with Raspberry Pi and implement real-time air quality monitoring.														4

Total Hours		52
Text Books		
1. Arshdeep Bahga, Vijay Madisetti, " Internet of Things- A Hands On Approach", Universities press, 2014.		
Reference Book		
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)		
2. Srinivasa K G, "Internet of Things", CENGAGE Learning India, 2017.		
Online References		
1. NPTEL Course: Prof. Sudip Misra, Indian Institute of Technology Kharagpur, "Introduction to Internet of Things – Course" [https://nptel.ac.in/courses/106105166]		



Semester VI														
Course Code:ET24AEC361					Course Name: Reasoning and Aptitude Development II									
Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	-	1	-	-	-	-	25	-	-	25	-	-	-	1
Prerequisite: Basic Mathematical Concepts														
Course Objectives: • To develop numerical computation skills using averages, alligation, time–speed–distance, and time–work concepts for solving real-life quantitative problems. • To apply mathematical reasoning techniques to special cases involving trains, boats & streams, circular motion, and work-based systems. • To interpret and analyze data presented in tables, pie charts, bar graphs, and line graphs using efficient calculation and approximation techniques. • To strengthen logical and analytical reasoning abilities through coding–decoding, series analysis, and structured critical reasoning problems. • To understand and apply principles of permutations, combinations, and probability to solve counting and chance-based problems accurately. • To build exam-oriented problem-solving strategies including time management, question selection, elimination methods, and decision-making under constraints. Course Outcomes: After completing the course, the students will be able to: CO1: To solve average and allegation problems involving weighted averages and mixture applications in profit, interest, and speed scenarios. CO2: To analyze and compute time–speed–distance and time–work problems, including special cases such as trains, boats & streams, circular tracks, and pipes & cisterns. CO3: To accurately interpret data and assess data sufficiency, applying logical checks and efficient calculation strategies to reach valid conclusions. CO4: To identify patterns and logical relationships in coding–decoding, number series, and alphanumeric sequences to derive correct solutions. CO5: To evaluate arguments and deductions critically, distinguishing between strong and weak reasoning in assumptions, conclusions, and cause–effect relationships. CO6: To apply strategic problem-solving and decision-making techniques to optimize accuracy and time efficiency in competitive and placement examinations.														
Unit	Contents													Hrs
1	Averages & Alligations • Arithmetic Mean of Series (Consecutive numbers) • Concept of Weighted Average • Deviation Method (Assumed Mean) • Alligation Rule (Cross method for mixing two groups) • Application of Alligation in Profit, Interest, and Speed													2
2	Time, Speed & Distance (TSD) • Basic Formula and Unit Conversions (km/hr to m/s) • Average Speed (Total Distance / Total Time) • Harmonic Mean for equal distance intervals • Late/Early arrival logic (Constant Distance) • Relative Speed (Same direction vs. Opposite direction)													2

3	TSD Special Cases - Trains: Crossing poles, platforms, and other trains - Boats & Streams: Upstream and Downstream - Circular Tracks: First meeting point and meeting at starting point	2
4	Time & Work - Efficiency and Days (Inverse Relationship) - LCM Method for calculating total work - Alternate day working models - Negative Work (Pipes and Cisterns / Leaks)	2
5	Data Interpretation & Sufficiency - Calculation Hacks for DI (Approximation/Elimination) - Pie Charts (Degree to Percentage conversion) - Bar Graphs and Line Graphs (Growth rates) - Table-based DI (Missing data) - Data Sufficiency Logic (Check Statement 1, 2, then Both/Neither)	2
6	Coding-Decoding & Series - Letter-to-Letter and Letter-to-Number coding - Number Series (Difference, Double difference, Square/Cube patterns) - Alphanumeric Series and Symbol sequences	2
7	Critical Reasoning I (Arguments) - Identifying Premises, Conclusions, and Intermediate Conclusions - Assumption Identification (Negation Test) - Strengthening and Weakening Arguments	2
8	Critical Reasoning II (Deductions) - Statement & Conclusion - Statement & Course of Action - Cause and Effect relationships - Assertion and Reason - Strong vs. Weak Arguments	2
9	Permutation, Combination & Probability - Fundamental Principles of Counting (Addition vs. Multiplication) - Arrangements (Word formation, Circular Permutation) - Selection (Combinations) - Probability basics (Coins, Dice, Playing Cards) - Probability of "At least" and "At most" cases	2
10	Strategy & Decision Making - Question Selection (Identifying "Low-Hanging Fruit") - Elimination Techniques for Puzzles - Time-boxing for different sections - Decision Making (Criteria-based selection sets) - Full-length Mock Review	2
Total Hours		20
Text Books		
1. R. S. Aggarwal, "Quantitative Aptitude", S. Chand Publishing, New Delhi. 2. M. Tyra, "Speed Mathematics", BSC Publishing, New Delhi.		

3. K. Kundan, "Logical Reasoning", Arihant Publications, New Delhi.
4. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning (Puzzles), S. Chand Publishing, New Delhi.
5. M. K. Pandey, Analytical Reasoning and Critical Thinking, Arihant Publications, New Delhi.
6. A. Sharma, Data Interpretation and Logical Reasoning (Advanced Level), McGraw-Hill Education, New Delhi.

