D Y PATIL
DEEMED TO BE
UNIVERSITY

SCHOOL *of* ENGINEERING & MANAGEMENT
KOLHAPUR

Electronics and Telecommunication Engineering
T.Y. B. Tech Semester-V
Structure and Curriculum
Scheme 2024-28

Department of E & TC Engineering

w. e. f. A.Y.: 2025-26

D.Y. PATIL EDUCATION SOCIETY Deemed to be University Kasaba Bawada, Kolhapur School of Engineering & Management KOLHAPUR

D.Y. Patil Education Society, Kolhapur (Deemed to be University)
School of Engineering & Management
Kasaba Bawada, Kolhapur
Teaching and Evaluation Scheme from Year 2024-28 (as per NEP-2020)
Department of Electronics and Telecommunication Engineering

T.Y B.Tech SEMESTER-V

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ETCU5P01	Program Core Courses	PCC	Digital System Design using Verilog	3	3	-	-	20	30	50	-	-	100
24ETCU5P02			Linear Integrated circuit	3	3	-	-	20	30	50	-	-	100
24ETCU5P03			Electromagnetic and Anntena Wave Prapogation	3	3	-	-	20	30	50	-	-	100
24ETCU5P04			Digital System Design using Verilog Lab	1	-	2	-	-	-	-	25	25	50
24ETCU5P05			Linear Integrated circuit Lab	1	-	2	-	-	-	-	25	25	50
24ETCU5P06			Electromagnetic and Anntena Wave Prapogation Lab	1	-	2	-	-	-	-	25	-	25
24ETCU5M07	Multudisciplinary Minor	MDM-3	Microcontrollers(RISC)	3	3		-	20	30	50	-	-	100
24ETCU5M08			Microcontrollers(RISC)-Lab	1	-	2	-	-	-	-	25	-	25
24ETCU5O09	Open Elective Course	OCE-III	Biomedical Instrumentation	2	2	-	-	-	-	50	-	-	50
24ETCU5O10			Industrial Automation-II										
24ETCU5E11	Professional Elective	PEC 1	Information theory & coding	4	4	-	-	20	30	50	-	-	100
24ETCU5E12			Microelectronics										
24ETCU5E13			Network Analysis										
24ETCU5D14	Mandatory Course	MC	Finishing School Training V	Audit	3*	-	-	50	-	-	-	-	Grade
24ETCU5C15	Co-Curricular Activities	CCA	Liberal Learning-V	Audit	2#	-	-	50	-	-	-	-	Grade
24ETCU5C16			Liberal Learning-VI										
			Total	**22**	**18**	**8**	**0**	**200**	**150**	**300**	**100**	**50**	**700**
24ETCU5Z03	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- II (ODL only) Semiconductor device modelling and simulation	3	2	-	-	20	30	50	-	-	100
24ETCU5Z04	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- II (ODL only) Semiconductor device modelling and simulation Lab	1	-	-	-	-	-	-	25	-	25

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T.Y. B. Tech. Curriculum.w.e.f.A.Y.2026-2027
(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P01, Digital System Design using Verilog**
Prerequisite/s			Number system, Digital Logic
Teaching Scheme: Lecture/Tutorial/Practical			**03**/--/--
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	--/--/--
		Total	**100**

Course Description: This course covers the analysis and design of combinational and sequential digital circuits, including counters, finite state machines, and programmable logic devices. It introduces Verilog HDL for modeling, simulation, and implementation of digital systems using behavioral, structural, and dataflow descriptions. The course also provides hands-on exposure to FPGA-based design flow and modern digital system development using EDA tools.

Course Objectives:

1	To Explain the fundamentals of digital system design and Verilog HDL.
2	To Demonstrate the design and implementation of combinational and sequential digital circuits using Verilog HDL.
3	To Illustrate the design and analysis of counters and finite state machines using Verilog HDL.
4	To familiarize students with PLDs, FPGA architecture and the FPGA design flow.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Apply Verilog HDL fundamentals to model and verify basic digital circuits.
2	Design combinational logic circuits using Verilog HDL.
3	Design sequential circuits, counters and finite state machines using Verilog HDL.
4	Explain programmable logic devices, FPGA architecture and design flow.

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
CO1	3	2	2	1	2	-	-	-	-	-	-	-			IV
CO2	3	2	2	1	2	-	-	-	-	-	-	-			IV
CO3	3	2	2	1	2	-	-	-	-	-	-	-			IV
CO4	3	2	1	1	-	-	-	-	-	-	-	-			IV

Content	Hrs.
Unit I: Verilog Fundamentals Introduction to Digital System Design, Need for HDL, Verilog module structures: Data types, Operators, Modeling styles: Data Flow description, Behavioral and Structural description, Basic Logic Gates using Verilog, Introduction to Testbench Simulation and Functional Verification	8
Unit II: Basic Combinational Logic Design using Verilog Verilog Modeling of Basic Combinational Circuits using Dataflow and Behavioral Descriptions : Half Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Parallel Adder, Carry Look-Ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Code Converters	6
Unit III: Advanced Combinational Logic Design using Verilog Verilog Modeling of Advanced Combinational Circuits using Dataflow, Behavioral and Structural Descriptions : Decoder, Encoder, Priority Encoder, Magnitude Comparator, 8-bit ALU, Parity Generator/Checker, Seven Segment Decoder,	7
Unit IV: Sequential Logic Design using Verilog Behavioral Modeling, Simulation and Functional Verification of Sequential Circuits using Verilog: Latches, SR, D, T, JK, Master-Slave JK, Edge Triggered Flip-Flops, Preset and Clear Excitation Table, Characteristic Equation, Flip-Flop Conversion, Timing Parameters, Shift Registers,	7
Unit V: Counters and FSM using Verilog Ripple Counter, Synchronous Counter, Up/Down Counter, Ring Counter, Johnson Counter, MOD-N Counter, Moore Machine, Mealy Machine, State Diagram, State Table, State Assignment, State Reduction, Sequence Detector, Behavioral Modeling, Simulation and Functional Verification of Counters and Finite State Machines using Verilog.	7
Unit VI: Programmable Logic Devices (PLDs) Overview of PLDs: PROM, PLA, PAL, GAL, CPLD, FPGA.FPGA Architecture and Design Flow: From specification to bitstream. Tool for FPGA Design: Xilinx ISE, Implementing Digital Systems on FPGA/CPLD : Synthesis, place and route, bitstream generation.	7

Text Books:

1	Digital Design, 5th Edition M. Morris Mano and Michael D. Ciletti, Pearson 2013
2	Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar, Pearson Education
3	Fundamentals of Logic design with Verilog, 2nd Edition, Stephen Brown and Zvonko Vranesic McGrawHill publication, 2010

Reference Books:

1	Verilog Digital System Design, 2nd Edition, Zainalabdien Navabi, TMH
2	Modern Digital Electronics, 4th Edition R.P.Jain, Tata McGraw-Hill Education

	Useful Links
1	https://onlinecourses.nptel.ac.in/e-learning/course/noc26_ee177
2	https://onlinecourses.nptel.ac.in/e-learning/course/noc26_ee120

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T.Y. B. Tech. Curriculum w. e. f. A.Y. 2025-2026
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P02, Linear Integrated Circuits**
Prerequisite/s			Basic knowledge of Basic Electronics Engineering
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course provides a comprehensive study of linear integrated circuits , focusing on the design, analysis, and applications of operational amplifiers and other analog ICs. It covers internal circuit configurations, characteristics, and practical usage in signal processing, instrumentation, and control systems, preparing students for advanced analog electronic design.

Course Objectives:

1	Select an appropriate Op-amp for a particular application by referring data sheets.
2	Design Op-amp Op-amp-based circuit to give the specified gain.
3	Explain the frequency response characteristics of an amplifier using Op-amp.
4	Compute component values to design different Op-amp based circuits which include arithmetic building blocks, filters, waveform generators etc
5	Understand the functionalities of PLL and its use in various applications in communication and control systems
6	Understand the working and applications of IC555, IC565, and other special-purpose ICs

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Explain the internal circuit of the operational amplifier and its electrical parameters.
2	Discuss the importance of an Op-amp in building an analog computer.
3	Explain the application of Op-amps in building signal conditioning circuits, filters, waveform generators etc.
4	Develop practical skills for building and testing circuits using analog ICs.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	1	2	3	-	-	1	1	1	1	2	1	
CO2	3	3	3	2	3	-	1	-	-	1	2	2	1	1
CO3	3	3	1	2	2	-	1	-	-	1		2	2	2
CO4	3	3	3	3	3	-	1	-	-	1	2	2	1	-
CO5	3	3	2	2	2	-	2	-	-	1	1	3	-	-
CO6	3	2	2	2	2	-	1	-	-	1	1	2	-	-

Content	Hrs.
Unit-I Introduction to op-amp Definition, symbol, Block diagram of OP-AMP, Explanations of each block, Differential Amplifier configurations, Differential amplifier analysis (AC & DC) for dual-input balanced-output configuration using 'r' parameters, level shifter, current mirror circuits, ideal parameters and practical parameters of OP-AMP and their comparison, internal circuit of IC741. detail circuit analysis of IC CA3140	7
Unit II: Op-amp Configurations Virtual ground concept, Open loop configuration, closed loop configuration, unity gain amplifier, frequency Response of both configurations, Stability considerations, Frequency Compensation, Slew Rate.	7
Unit III: Applications of Op-amp Summing, Scaling & Averaging Amplifiers using Op-amps, Differential amplifier using op-amp, Subtractor Circuit, Instrumentation amplifier, V to I & I to V Converter, Precision Rectifiers, Log & Anti-log Amplifiers, Study of comparator, Schmitt Trigger, Window Detector, Clippers & Clampers, Peak Detectors, Sample & Hold Circuits.	7
Unit IV: Filters Introduction, Analysis & Design of Butterworth filters: High Pass filter, Low Pass filter (First & Second order), Band Pass filter, Band Reject filter, All Pass Filter, Introduction to Chebyshev Filter, notch filter.	7
Unit V: Waveform Generators Analysis & Design of Square wave generator, Triangular wave generator, Sawtooth wave generator. Analysis & Design of RC phase shift oscillator, RC wein bridge oscillator, Colpitts oscillator, Hartley oscillator..	7
Unit VI: Special purpose ICs IC 555 Timer: Block Diagram, Operating Principle, Multi-vibrator using IC 555. IC 565 PLL: Operating Principles, applications, Introduction of (block diagram, features, application areas) : IC OP177 opamp, IC AD620 instrumentation amplifier	7

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Text Books:

1	Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education second and latest edition
2	Salivahanan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill,India 2008

Reference Books:

1	Robert Coughlin, Fredric Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth edition, PE, 2006. (Ch-6)
2	David Bell, "Operational Amplifiers and Linear ICs", Third ed, Oxford University Press
3	B. Somanathan Nair, "Linear Integrated Circuits- Analysis, Design & Applications", Wiley India.
4	Datasheets

Useful Links	
1	https://www.youtube.com/watch?v=lpXNCwsnxjM&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3

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T.Y. B. Tech. Curriculum w. e. f. A.Y. 2025-2026
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P03, Electromagnetic and Antenna Wave Propagation**
Prerequisite/s			A strong foundation in basic calculus (differential and integral) and vector algebra is essential.
Teaching Scheme: Lecture/Tutorial/Practical			**03/00**/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces the fundamental mathematical and physical concepts of static and time-varying electromagnetic fields, culminating in the study of Maxwell's equations, wave propagation, and transmission lines. Students will learn to analyze electromagnetic phenomena and apply these principles to practical engineering problems.

Course Objectives:

1	To introduce the fundamental concepts of electromagnetic fields, including scalar and vector quantities.
2	To explain the principles governing electrostatic and magneto static fields.
3	To discuss the concepts of time-varying electromagnetic fields and Maxwell's equations.
4	To define the characteristics of plane electromagnetic waves in different media

Course Outcomes (COs):
At the end of the course the student will be able to:

CO1	Apply Vector Analysis to Electromagnetic Fields.
CO2	Analyze Static Electromagnetic Fields and Their Interactions with Materials.
CO3	Utilize Maxwell's Equations to Analyze Time-Varying Electromagnetic Phenomena and Wave Propagation.
CO4	Evaluate Transmission Line Characteristics and Their Applications.

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Course Outcomes (COs) with Program Outcomes (POs):

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO2	3	3	2	2	1	1	1	-	-	-	-	-	2	1
CO3	3	3	2	2	2	1	1	-	-	-	-	-	2	1
CO4	3	2	3	1	3	1	1	-	-	-	-	-	2	1

Content	Hrs.
Unit I: Fundamentals of Electromagnetic Fields Introduction and Significance of Electromagnetic Fields, Scalar, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems Line, surface and volume integrals Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Verify theorems, Curl of a vector field, Stoke's theorem, Verify theorems, Null identities, Helmholtz's theorem	7
Unit II: Static Electromagnetic Fields **Electrostatic Field:** Coulomb's Law, Electric Field Intensity, Electric Field due to Distributed Charges, Flux Density, Gauss Law and Applications, Divergence Theorem, Work Done, Electric Potential, Potential Gradient, Electric Dipole, Polarization, Electrostatic Energy Density, Boundary Conditions for Electrostatic Field. **Magnetostatic Field:** Biot-Savart Law, Ampere's Circuital Law and Application, Stoke's Theorem, Magnetic Flux Density, Magnetic Scalar & Vector Potential, Energy Stored in Magnetic Field, Boundary Conditions for Magnetic Field.	7
Unit III: Time-Varying Fields and Electromagnetic Waves Continuity Equation for Static Conditions, Displacement Current, Faraday's Law, Inconsistency of Ampere's Law, Maxwell's Equations in Point and Integral Form, Maxwell's Equations for Time Varying Fields, Wave Propagation in Perfect Dielectric, Lossy Dielectric and Conducting Media, Wave Equations for Sinusoidal Time Variations, Poynting Theorem and Power Flow in Electromagnetic Field, Skin Depth, Phase Velocity and Group Velocity.	7
Unit IV: Wire Antennas Antenna parameters, Linear Antennas, Infinitesimal dipole, small dipole, finite and half wave dipole, loop antenna. Antenna Arrays: Two element array, N-element array Uniform spacing and uniform non-uniform amplitude, binomial array, Dolph -Tschebyscheff's Array, planar and circular array.	7
Unit V: Aperture Antennas Circular Apertures, Rectangular Aperture, Horn Antenna: E-plane, HPlane pyramidal and conical horn antenna, Reflector Antennas: Plane Reflector, Corner reflector and Parabolic Reflector.	6
Unit VI: Travelling Wave Antennas Long wire, V Antenna, Rhombic Antenna, Broad band Antennas: Helical Antenna, Yagi-Uda of Linear elements, Yagi - Uda Array of Loops, Spiral Antennas, Log-Periodic Antenna. **Microstrip Antennas:** Basic Characteristics, feeding methods, methods of analysis, rectangular circular patch, quality factor, bandwidth efficiency, input impedance, circular polarization,	8

arrays and feed networks.	

Text Books:

1	William Hayt, "Engineering Electromagnetics", Mc Graw Hill.
2	John. D. Kraus, "Antennas & Wave Propagation", Fifth Edition, Tata McGraw Hill.
3	C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley.

Reference Books:

1	E.C. Jordan & K.G. Balmain, "Electromagnetic waves & Radiating Systems", Prentice Hall, India
2	K.D. Prasad, "Antenna & Wave Propagation" Satya Prakashan
3	G. S. N. Raju, "Antennas and Wave Propagation", Pearson Education.

Useful Links	
1	https://archive.nptel.ac.in/courses/108/106/108106073/
2	https://archive.nptel.ac.in/courses/108/104/108104099/

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T.Y B. Tech. Curriculum.w.e.f.A.Y.2026-2027
(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P04, Digital System Design using Verilog Lab**
Prerequisite/s			Number system, Digital Logic, Programming
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/--**
	P	**INT / OE/POE**	**25/--/25**
		Total	**50**

Course Description:

This course provides fundamental knowledge of combinational and sequential digital logic design, semiconductor memories, and programmable logic devices (PLDs). It introduces Verilog HDL for modeling, simulation, and verification of digital circuits using EDA tools. The course emphasizes practical implementation through laboratory experiments and a mini-project in digital system design.

Course Objectives:

1	To develop practical skills in designing and simulating digital circuits using Verilog HDL.
2	To demonstrate the implementation and functional verification of combinational and sequential logic circuits using Verilog HDL.
3	To enhance students' understanding of digital system design through simulation, debugging, and waveform analysis.
4	To encourage the development of real-world digital systems through Verilog-based mini projects.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Design and simulate basic digital circuits using Verilog HDL.
2	Design and verify combinational logic circuits using Verilog HDL.
3	Design and verify sequential logic circuits, counters, and sequence detectors using Verilog HDL.
4	Develop and demonstrate a Verilog HDL-based digital system for a real-world application.

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
CO1	3	3	2	2	3	-	-	-	-	-	-	-			III
CO2	3	2	3	2	3	-	-	-	-	-	-	-			III
CO3	3	3	3	3	3	-	-	-	-	-	-	-			III
CO4	3	2	3	3	2	-	-	-	-	-	-	-			VI

List of Experiments		
Exp. No.	**Name of the Experiment**	**Hrs.**
1	To design and simulate basic logic gates using Verilog HDL.	2
2	To design and simulate half adders, full adders using Verilog HDL.	2
3	To design and simulate half subtractor, full subtractor using Verilog HDL.	2
4	To design and simulate Multiplexers using Verilog HDL.	2
5	To design and simulate De-multiplexer using Verilog HDL.	2
6	To design and simulate Decoder using Verilog HDL.	2
7	To design and simulate 4 - Bit binary to gray code converter & 4 - Bit gray to binary code converter using Verilog HDL	2
8	To design and simulate Comparator using Verilog HDL.	2
9	To design and simulate D, T flip flops using Verilog HDL.	2
10	To design and simulate shift register using Verilog HDL.	2
11	To design and simulate Binary counter using Verilog HDL.	2
12	To design and simulate Sequence Detector using Verilog HDL.	2
13	Verilog based Mini project.	6

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Reference Books:

1	Fundamentals of Logic design with Verilog, 2nd Edition, Stephen Brown and Zvonko Vranesic McGrawHill publication, 2010
2	Zainalabdien Navabi, Verilog Digital System Design, 2nd Edition, TMH
3	Verilog HDL, Samir Palnitkar, 2nd Edition, Pearson Education, 2009.

Useful Links	
1	https://onlinecourses.nptel.ac.in/e-learning/course/noc26_ee177
2	https://onlinecourses.nptel.ac.in/e-learning/course/noc26_ee120
3	https://www.youtube.com/watch?reload=9&v=vHLBO05TeyU&list=PLwdnzlV3ogoV1Y7iVqr-FhWUQEX7JDdiP

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P05, Linear Integrated Circuit Lab**
Prerequisite/s			Basic knowledge of Basic Electronics Engineering
Teaching Scheme: Lecture/Tutorial/Practical			00/**02**/00
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: This course provides a comprehensive study of linear integrated circuits, focusing on the design, analysis, and applications of operational amplifiers and other analog ICs. It covers internal circuit configurations, characteristics, and practical usage in signal processing, instrumentation, and control systems, preparing students for advanced analog electronic design.

Course Objectives:

1	Explain the internal circuit of the operational amplifier and its electrical parameters.
2	Discuss the importance of an Op-amp in building an analog computer.
3	Explain the application of Op-amps in building signal conditioning circuits, filters, waveform generators etc.
4	Develop practical skills for building and testing circuits using analog ICs.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Select an appropriate Op-amp for a particular application by referring data sheets.
2	Design Op-amp Op-amp-based circuit to give the specified gain.
3	Explain the frequency response characteristics of an amplifier using Op-amp.
4	Compute component values to design different Op-amp based circuits which include arithmetic building blocks, filters, waveform generators etc
5	Understand the functionalities of PLL and its use in various applications in communication and control systems
6	Understand the working and applications of IC555, IC565, and other special-purpose ICs

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO 2
CO1	3	2	1	2	3	-	-	1	1	1	1	2	1	-
CO2	3	3	3	2	3	-	1	-	-	1	2	2	1	1
CO3	3	3	1	2	2	-	1	-	-	1		2	2	2
CO4	3	3	3	3	3	-	1	-	-	1	2	2	1	-
CO5	3	3	2	2	2	-	2	-	-	1	1	3	-	-
CO6	3	2	2	2	2	-	1	-	-	1	1	2	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	Study of Inverting amplifier for DC & AC inputs using Opamp
2	Study of Non-Inverting amplifier for DC & AC inputs using opamp
3	Frequency Response of Inverting & Non-Inverting amplifier using opamp
4	Study of op-amp as Summing, Scaling, & Averaging amplifier in Inverting & Non-Inverting
5	Study of V-I & I-V Converter
6	Study of Schmitt Trigger using opamp & Window detector using opamp
7	Study of Comparator & Zero Crossing Detector using opamp
8	Study of Butterworth Filter using opamp
9	Study of Triangular & square wave generator using opamp
10	Design of IC 555 Timer as Astable & Monostable Multivibrator
11	Study of IC NE 565 PLL 15.
12	Study of Wein Bridge Oscillator using opamp.
13	Study of Function Generator using IC 8038

Text Books:

1	Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education second and latest edition
2	Salivahanan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill,India 2008

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Reference Books:

1	Robert Coughlin, Fredric Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth edition, PE, 2006. (Ch-6)
2	David Bell, "Operational Amplifiers and Linear ICs", Third ed, Oxford University Press
3	B. Somanathan Nair, "Linear Integrated Circuits- Analysis, Design & Applications", Wiley India.
4	Datasheets

Useful Links	
1	https://www.youtube.com/watch?v=lpXNCwsnxjM&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3

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T.Y. B. Tech. Curriculum w. e. f. A.Y. 2025-2026
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5P06, Electromagnetic and Antenna Wave Propagation Lab**
Prerequisite/s			Basic knowledge of Basic Electronics Engineering
Teaching Scheme: Lecture/Tutorial/Practical			00/00/02
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

Course Description: This course introduces the fundamental mathematical and physical concepts of static and time-varying electromagnetic fields, culminating in the study of Maxwell's equations, wave propagation, and transmission lines. Students will learn to analyze electromagnetic phenomena and apply these principles to practical engineering problems.

Course Objectives:

1	To introduce the fundamental concepts of electromagnetic fields, including scalar and vector quantities.
2	To explain the principles governing electrostatic and magneto static fields.
3	To discuss the concepts of time-varying electromagnetic fields and Maxwell's equations.
4	To introduce the fundamental concepts of electromagnetic fields, including scalar and vector quantities.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Apply Vector Analysis to Electromagnetic Fields.
2	Analyze Static Electromagnetic Fields and Their Interactions with Materials.
3	Utilize Maxwell's Equations to Analyze Time-Varying Electromagnetic Phenomena and Wave Propagation.
4	Evaluate Transmission Line Characteristics and Their Applications.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO 2
CO1	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO2	3	3	2	2	1	1	1	-	-	-	-	-	2	1
CO3	3	3	2	2	2	1	1	-	-	-	-	-	2	1
CO4	3	2	3	1	3	1	1	-	-	-	-	-	2	1

List of Experiments	
Expt. No.	**Name of Experiment**
1	Write MATLAB program to simulate the radiation pattern of Hertzian Dipole antennas
2	Write MATLAB program to simulate the radiation pattern of Finite Length Dipole antennas
3	Write MATLAB program to simulate the radiation pattern of Half Wave Dipole antennas
4	Carry out the Far Field Measurements and Plot the Radiation pattern and find the directivity, gain, effective length for the Half wave dipole
5	Carry out the Far Field Measurements and Plot the Radiation pattern and find the directivity, gain, effective length for the Helix Antenna
6	Write Program for Antenna arrays to plot the radiation pattern for End-Fire, Broadside, Binomial, Tschebyshev"s
7	To measure the gain and E-plane/H-plane beamwidths of a pyramidal or conical horn antenna.
8	To study the directive properties, gain, and front-to-back ratio of a Yagi-Uda antenna.
9	Measurement of radiation pattern of 3 element Yagi-UDA antenna
10	Measurement of radiation pattern of 5 element Yagi-UDA antenna
11	Measurement of radiation pattern of 7 element Yagi-UDA antenna

Text Books:

1	William Hayt, "Engineering Electromagnetics", Mc Graw Hill.
2	John. D. Kraus, "Antennas & Wave Propagation", Fifth Edition, Tata McGraw Hill.
3	C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley.

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Reference Books:

1	E.C. Jordan & K.G. Balmain, "Electromagnetic waves & Radiating Systems", Prentice Hall, India
2	K.D. Prasad, "Antenna & Wave Propagation" Satya Prakashan
3	G. S. N. Raju, "Antennas and Wave Propagation", Pearson Education.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2	https://onlinecourses.nptel.ac.in/noc20_ee20/preview

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5M07, Microcontrollers (RISC)**
Prerequisite/s			A foundational understanding of digital electronics and basic programming concepts
Teaching Scheme: Lecture/Tutorial/Practical			**03**/--/--
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	--/--/--
		Total	**100**

Course Description: This course explores RISC microcontroller architectures, contrasting them with CISC designs, and delves into the specifics of AVR and ARM Cortex-M series microcontrollers. Students will gain practical skills in programming and interfacing these devices with essential peripherals for embedded system applications.

Course Objectives:

1	Explain the fundamental architectural differences between CISC and RISC microcontrollers
2	Demonstrate the architecture, instruction set, and programming.
3	Describe the key features of ARM Cortex-M series microcontrollers.
4	Illustrate the principles and practical implementation of interfacing various peripherals

Course Outcomes (COs):

At the end of the course the student will be able to:

1	To compare and contrast CISC and RISC architectures
2	To program AVR microcontrollers (e.g., ATmega328) in both assembly and C
3	To explain the architectural components, memory map, and interrupt handling mechanisms
4	To design and implement interfacing solutions for various peripherals

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	-	3	-	-	-	-	1	-	2	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	3	3	2	3	1	-	-	1	1	1	2	-	-

Content	Hrs.
Unit 1: Introduction to Microcontrollers & RISC Architecture Comparison between CISC and RISC architectures, Harvard vs Von Neumann architecture, Overview of RISC microcontrollers (e.g., ARM, AVR, PIC), Features and advantages of RISC-based microcontrollers, Introduction to Embedded Systems & Applications.	7
Unit 2: AVR Microcontroller Architecture (e.g., ATmega328) Pin configuration and architecture, I/O ports and memory organization, Instruction set (RISC format), addressing modes, Programming using assembly and C	7
Unit 3: ARM Cortex-M Series Microcontroller ARM Cortex-M series overview (Cortex-M0/M3/M4), Registers, pipeline, and exceptions, NVIC (Nested Vector Interrupt Controller), Memory map, bit-banding, Thumb instruction set	7
Unit 4: Peripherals and Interfacing (RISC-Based MCUs) Timers and Counters, ADC/DAC interfacing, Serial communication protocols: UART, SPI, I2C, GPIO programming, PWM, DC motor, and servo motor control	7

Text Books:

1	"The AVR Microcontroller and Embedded Systems" – Mazidi, Naimi, & Mazidi
2	"ARM System Developer's Guide" – Andrew Sloss

Reference Books:

1	"Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C" – Yifeng Zhu
2	Datasheets: ATmega328P, STM32F103, ARM Cortex-M series

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5M08, Microcontrollers(RISC)-Lab**
Prerequisite/s			A foundational understanding of digital electronics and basic programming concepts
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

Course Description: This course explores RISC microcontroller architectures, contrasting them with CISC designs, and delves into the specifics of AVR and ARM Cortex-M series microcontrollers. Students will gain practical skills in programming and interfacing these devices with essential peripherals for embedded system applications.

Course Objectives:

1	Explain the fundamental architectural differences between CISC and RISC microcontrollers
2	Demonstrate the architecture, instruction set, and programming.
3	Describe the key features of ARM Cortex-M series microcontrollers.
4	Illustrate the principles and practical implementation of interfacing various peripherals

Course Outcomes (COs):
At the end of the course the student will be able to:

1	To compare and contrast CISC and RISC architectures
2	To program AVR microcontrollers (e.g., ATmega328) in both assembly and C
3	To explain the architectural components, memory map, and interrupt handling mechanisms
4	To design and implement interfacing solutions for various peripherals

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	-	3	-	-	-	-	1	-	2	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	3	3	2	3	1	-	-	1	1	1	2	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	Overview of popular microcontroller simulators (MPLAB X Simulator, Proteus, Keil µVision Simulator, AVR Studio Simulator)
2	Basic I/O Simulation Simulate LED blinking program using GPIO pins
3	Delay Generation Implement software delay using loops
4	Timer Simulation Configure timers in simulation
5	Interrupt Simulation Enable and simulate external interrupt on pin change
6	ADC Simulation Simulate analog input readings using ADC modules (in simulators supporting analog models)
7	Serial Communication Simulation Simulate UART transmission and reception
8	Peripheral Interfacing Simulation LCD display simulation (16x2 LCD)
9	Mini Project Integrate multiple modules: e.g., sensor data acquisition + display + communication

Text Books:

1	"The AVR Microcontroller and Embedded Systems" – Mazidi, Naimi, & Mazidi
2	"ARM System Developer's Guide" – Andrew Sloss

Reference Books:

1	"Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C" – Yifeng Zhu
2	Datasheets: ATmega328P, STM32F103, ARM Cortex-M series

Useful Links
https://onlinecourses.nptel.ac.in/noc22_ee12/preview

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5O09, Biomedical Instrumentation**
Prerequisite/s			Electronic circuits, and signal processing fundamentals
Teaching Scheme: Lecture/Tutorial/Practical			**02**/--/--
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/50**
	P	**INT / OE/POE**	--/--/--
		Total	**50**

Course Description: This course provides a foundational overview of biomedical instrumentation, covering bio signal acquisition, diagnostic analyzers, therapeutic devices, and medical imaging systems. It emphasizes the role of electronics in healthcare monitoring and diagnosis. The course prepares students for careers in medical device design, hospital equipment maintenance, diagnostic labs, healthcare technology management, and further studies in biomedical engineering or clinical research.

Course Objectives:

1	To understand the principles of biosignal generation, acquisition, and analysis in biomedical systems.
2	To familiarize students with key analytical instruments used in clinical diagnostics.
3	To explore the design and functioning of medical therapeutic devices and biomedical lasers.
4	To introduce modern medical imaging technologies and discuss noise reduction in low-level biomedical measurements.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Understand and Analyze bio-signal acquisition and analysis.
2	Explain key clinical analytical instruments.
3	Describe therapeutic medical devices.
4	Analyze and interpret medical imaging data and signal recording systems

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	1	2	2	1	-	-	-	1	-	2	-	3
CO2	3	2	2	1	2	2	-	-	-	-	-	1	-	3
CO3	3	2	2	1	2	1	1	-	-	-	-	1	-	3
CO4	3	2	2	2	3	-	-	-	-	1	-	2	-	3

Content	Hrs.
Unit 1: Introduction to biomedical engineering Biosignal: Physiological systems – Bioelectric potentials – Electrodes – Transducers – Block diagram of biomedical instrumentation system – System approach to biological systems – Physiological signal amplifiers – Medical preamplifier design – Analysis of periodic, aperiodic, and random signals – Acquisition of biomedical signals (ECG, EMG, EEG, EOG) – Concept only.	7
Unit 2: **Analytical Equipment** Concept and significance – Classification based on clinical application – Autoanalyzer – Blood gas analyzer – CBC analyzer – Coagulometer – ELISA Reader – Chemiluminescence Analyzer (CLIA) – PCR and qPCR – Basic working concept and DNA/RNA analysis – Analytical role of ECG and EEG systems.	7
Unit 3: Medical Therapeutic Equipment Cardiac Equipment: External and implantable pacemakers – Programmable pacemakers – Power sources – Design of encapsulation and leads – Pacing system analyzers Respiratory Equipment: Principles of electronic ventilators Electrotherapy Equipment: TENS – Interferential therapy Biomedical Lasers: Principles and applications – CO_2, HeNe, Nd:YAG, Ruby lasers.	7
Unit 4: Medical Imaging & Signal Recording Modern imaging systems: X-ray machines – Nuclear medical imaging – Magnetic Resonance Imaging (MRI) – Ultrasound – Computed Tomography (CT) – Thermal imaging Recording systems: Basic recording devices – Signal conditioners – Sources and types of noise in low-level biomedical signal measurement.	7

Text Books:

1	Dr. M. Arumugam, "Biomedical Instrumentation", Anuradha publications, 2nd ed., 1994.

Reference Books:

1	John G Webster, "Medical Instrumentation – Application and Design", 4th ed., John Wiley and Sons, 2007.
2	Leslie Cromwell, Fred. J. Weibell, Erich. A. Pfeiffer, "Biomedical Instrumentation & Measurements, 2nd ed., Pearson Education., 2001.

Useful Links	
1	https://onlinecourses.swayam2.ac.in/nou23_bt05/preview

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5O10, Industrial Automation-II**
Prerequisite/s			Knowledge of Digital Electronics and Mechatronics
Teaching Scheme: Lecture/Tutorial/Practical			**02**/--/--
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/50**
	P	**INT / OE/POE**	--/--/--
		Total	**50**

Course Description: To provide a clear view on Programmable Logic Controllers (PLC) & to learn the various methods involved in automatic control and monitoring & to familiarize with the communication protocol this course has been inducted.

Course Objectives:

1	To understand the architecture and working of PLC and its role in industrial automation.
2	To learn PLC programming using different instructions and logical operations.
3	To design and develop PLC-based automation solutions for industrial applications.
4	To introduce SCADA systems and develop basic SCADA applications integrated with PLC.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Explore the architecture of PLC and its functions.
2	Execute the various instructions and logic in PLC.
3	Develop the PLC program for various applications.
4	Design and develop the SCADA for various applications.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	1	-	-
CO2	3	3	2	-	3	-	-	-	-	-	-	1	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	2	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-	2	-	-

Content	Hrs.
UNIT- I: Programmable Logic Controllers Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section - Analog I/O modules - digital I/O modules CPU processor memory module - PLC programming Simple instructions - Output control devices - Latching relays PLC ladder diagram.	7
Unit- II: Instructions: Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions - Data manipulating instructions-math instructions	7
UNIT–III: Application of PLC Traffic light control, 24-hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, Motor Control.	7
Unit- IV: Networking of PLC and SCADA Networking of PLCs-Data Communication-Fieldbus, PROFI bus, and Mod bus-OSI Model types-OPC function. Supervisory Control and Data Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data Storage	7

Text Books:

1	Programmable Logic Controllers by, Frank D. Petruzella, McGraw-Hill Education
2	Programmable Logic Controllers: Principles and Applications by, John W. Webb & Ronald A. Reis, Pearson Education
3	Supervisory Control and Data Acquisition Stuart A. Boyer ISA (International Society of Automation)

Reference Books:

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1	Programmable Logic Controllers by, Petruzella Frank D, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2	Programmable Logic Controllers: Principles and Application by, Webb, John W., Fifth edition, Prentice Hall of India, New Delhi
3	SCADA: Supervisory Control and Data Acquisition by, Stuart A. Boyer, ISA Publication.

Useful Links	
1	NPTEL 12 weeks Industrial Automation and Control By Prof. Siddhartha Mukhopadhyay

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5E11, Information Theory and Coding**
Prerequisite/s			Understanding of linear algebra and discrete mathematics, Digital Communication
Teaching Scheme: Lecture/Tutorial/Practical			**04**/00/00
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces the foundational concepts of information theory and error control coding used in digital communication systems. It covers the measurement of information, source and channel coding theorems, and various types of codes such as Huffman, cyclic, BCH, and Reed-Solomon. Emphasis is placed on entropy, mutual information, and channel capacity for both discrete and continuous systems. Additionally, it explores methods of error detection and correction to improve data reliability in noisy communication channels

Course Objectives:

1	To understand the basic concepts and mathematical measures in information theory.
2	To study source and channel coding techniques and analyze their efficiency.
3	To explore error control coding methods for reliable communication.
4	To apply theoretical concepts in practical encoding/decoding scenarios.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Define and compute entropy, information rate, and mutual information.
2	Analyze and implement source coding algorithms such as Shannon and Huffman coding.
3	Evaluate the performance limits of communication channels and calculate channel capacity.
4	Explain and construct linear block codes, cyclic codes, and convolutional codes.
5	Apply error detection and correction techniques using matrix and syndrome-based approaches.
6	Design and evaluate advanced coding schemes such as BCH, RS, and Golay codes for real-world applications

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Course Outcomes (COs) with Program Outcomes (POs):

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	2	2	-	-	-	-	-	-	1	1	
CO2	3	3	-	2	2	-	-	-	-	-	-	1	1	1
CO3	3	3	-	2	2	1	-	-	-	-	-	1	2	2
CO4	3	2	2	2	2	-	-	-	-	-	-	1	2	-
CO5	3	2	2	2	3	-	-	-	-	-	-	1	1	-
CO6	3	2	2	2	3	-	-	-	-	-	1	2	-	-

Content	Hrs.
Unit I: Information Theory: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source	7
Unit II: Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.	6
Unit III: Fundamental Limits on Performance: Source coding theorem, Huffman coding, Discrete memoryless Channels, Mutual information, Channel Capacity. 6 Hours	6
Unit IV: Channel coding: Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem	6
Unit V: Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding. Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation. BCH codes.	7
Unit VI: Convolution Codes RS codes, Golay codes, shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes. Convolution Codes, Time domain approach. Transform domain approach.	7

Text Books:

1	Digital and analog communication systems, K. Sam Shanmugam, John Wiley, 1996
2	Digital communication, Simon Haykin, John Wiley, 2003

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Reference Books:

1	ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2	Digital Communications - Glover and Grant; Pearson Ed. 2nd Ed 2008

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee103/preview

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Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5E12, Microelectronics**
Prerequisite/s			Fundamental electrical concepts like voltage, current, resistance, and basic circuit elements.
Teaching Scheme: Lecture/Tutorial/Practical			**04/00**/00
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00**/00/00
		Total	**100**

Course Description: This course delves into the fundamental physics of semiconductors, exploring energy bands, charge carrier behavior, and the principles governing junctions. It then builds upon these foundations to analyze the operation and characteristics of essential electronic devices, including various transistors and optoelectronic components.

Course Objectives:

1	To provide a solid understanding of semiconductor devices for meaningful study of electronic circuits and systems.
2	To explain carrier transport phenomena using energy band theory and the Boltzmann transport equation.
3	To develop self-learning skills for understanding emerging semiconductor devices.
4	To prepare students for competitive exams like GATE and encourage higher studies.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Explain bandgap formation, p-n junction capacitance, and characteristics of LEDs and lasers.
2	Apply continuity and Poisson's equations to analyze carrier dynamics and p-n junction behavior.
3	Model BJT operation in different regions using the Ebers-Moll model.
4	Analyze BJT performance parameters such as current gain, base transport factor, and emitter efficiency.
5	Interpret C-V and I-V characteristics of MOS capacitors, JFETs, and MOSFETs, including key parameters

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	1

Content	Hrs.
Unit I: Energy Bands and Charge Carriers in Semiconductors Bonding forces and energy bands in solids, Charge carriers in semiconductors, Carrier concentration, drift of carriers in electric and magnetic fields, invariance of Fermi level at equilibrium.	6
Unit II: Excess Carriers in Semiconductors Diffusion of carriers, Diffusion current, Drift current, Mobility of carriers, Recombination, Continuity equation, Quasi Fermi levels, Gradients in Quasi Fermi levels, resistivity of materials	6
Unit III: Junctions Formation of p-n junctions, Equilibrium conditions, Steady state conditions, Transient and AC conditions, deviations from simple theory, Metal Semiconductor Junctions.	8
Unit IV: Field Effect Transistors JFET (characteristics), MOS capacitor (threshold voltage, C-V characteristics), MOSFET: I-V characteristics, Equivalent circuits for the MOSFET.	7
Unit V: Bipolar Junction Transistors Minority carrier distributions and terminal currents, Generalized Biasing: The Coupled-Diode Model, Charge control analysis; switching, drift in base region, base narrowing, avalanche breakdown, thermal effects, Kirk effect.	7
Unit VI: Optoelectronic Devices Photodiodes: I-V characteristics in an illuminated junction, Solar Cells, Photodetectors; LEDs, Semiconductor Lasers.	6

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Text Books:

1	B.G. Streetman, S. K. Banerjee, " Solid State Electronic Devices ", 7th edition, Pearson India Education Service Pvt. Ltd., 2017.
2	"Semiconductor Physics and Devices: Basic Principles" by Donald A. Neamen
3	"Solid State Electronic Devices" by Ben G. Streetman and Sanjay Kumar Banerjee

Reference Books:

1	S. M. Sze, "Physics of Semiconductor Devices", 2nd Edition, PHI, 2005.
2	Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 3rd Edition, McGraw Hill Higher Education, 2003

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T.Y. B. Tech. Curriculum w. e. f. A.Y. 2025-2026
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**24ETCU5E13, Network Analysis**
Prerequisite/s			Fundamental electrical concepts like voltage, current, resistance, and basic circuit elements.
Teaching Scheme: Lecture/Tutorial/Practical			**04/00/00**
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course provides a comprehensive understanding of fundamental electrical circuit analysis techniques, including network theorems, transient analysis, steady-state AC analysis, resonance, two-port networks, and basic filter design.

Course Objectives:

1	Apply fundamental circuit laws and network reduction techniques.
2	Analyze transient responses of first and second-order R-L, R-C, and R-L-C circuits with DC and AC excitation.
3	Apply the concepts of impedance and phasors to analyze the steady-state behavior of various circuits.
4	Explain the phenomenon of resonance in series and parallel RLC circuits.
5	Determine the y, z, h, and ABCD parameters of two-port networks.
6	Classify different types of filters based on their characteristics and pass/stop bands.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Simplify complex resistive networks using reduction techniques and network theorems to determine circuit variables.
2	Analyze the transient behavior of first and second-order circuits.
3	Analyze AC circuits in the steady state using impedance concepts and phasor diagrams.
4	Explain the phenomenon of resonance in electrical circuits.
5	Determine the parameters of two-port networks and analyze their interconnections in various configurations.
6	Design and analyze basic constant K and m-derived filters for specific frequency response characteristics.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs):

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO2	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO3	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	1
CO5	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO6	3	2	3	1	2	-	-	-	1	1	1	2	3	3

Content	Hrs.
Unit I: Circuit Fundamentals Types of circuit components, Types of Sources, Network reduction techniques-series, parallel circuits, Star-Delta conversion and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources also. Principal of Duality with examples. Network Theorems: Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer Theorem.	7
Unit II: Transients First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DC excitation and AC excitation. Response as related to s-plane rotation of roots. Laplace transform: introduction, Laplace transformation, basic theorems, problem solving using Laplace transform, partial fraction expansion, Heaviside's expansions, problem solving using Laplace transform.	7
Unit III: Steady State Analysis of A.C Circuits Impedance concept, phase angle, series R-L, R-C, R-L-C, circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem, solving using mesh and nodal analysis, numerical problems.	6
Unit IV: Resonance Circuits Series resonance circuit, Frequency response of a series resonant circuit, Effect of Q on bandwidth and selectivity, Relation between bandwidth and Q, Impedance of a series resonant circuit, Resonance by variation of L and C, Parallel resonant circuit.	6
Unit V: Two- port network parameters: y, z, h, A B C D Inter-conversion of two port networks, cascade connection series connection, series parallel connection, T and network representation of a two port network.	6
Unit VI: Filters Introduction, the neper and decibel, filter fundaments: pass and stop bands, characteristics of different filters, Design and analysis of constant K filter (low pass, high pass, band pass, and band stop filters): The m derived T section, the m derived π section.	7

Text Books:

1	A.Sudhakar, Shymmohan S. Palli, 'Circuit and Network – Analysis and Synthesis', 3rd Edition, Tata McGraw Hill Publication.
2	Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020
3	Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.

Reference Books:

1	D. Roy Choudhuri, 'Networks and Systems', New Age International Publisher.
2	M.E.Van Valkenburg, 'Network Analysis', IIIrd edition, Pearsons Education/PHI.
3	Soni Gupta, 'Electrical Circuit Analysis', Dhanpat Rai and Co.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc20_ee46/preview

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Electronics and Telecommunication Engineering
T.Y. B. Tech. Semester-VI
Structure and Curriculum
(Cycle 2024-28)

Department of E & TC Engineering

w. e. f. A.Y.: 2026-27

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D.Y. Patil Education Society, Kolhapu (Deemed to be University)
School of Engineering & Management
Kasaba Bawada, Kolhapur

Teaching and Evaluation Scheme from Year 2024-28 (as per NEP-2020)

Department of Electronics and Telecommunication Engineering

T.Y B.Tech SEMESTER-VI

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ETCU6P01	Program Core Courses	PCC	Microprocessor and Microcontroller	3	3	-	-	20	30	50	-	-	100
24ETCU6P02			Digital Signal Processing	3	3	-	-	20	30	50	-	-	100
24ETCU6P03			Computer Architecture and Organization	2	2	-	-	20	30	50	-	-	100
24ETCU6P04			Microprocessor and Microcontroller Lab.	1	-	2	-	-	-	-	25	25	50
24ETCU6P05			Digital Signal Processing Lab	1	-	2	-	-	-	-	25	25	50
24ETCU6M06	Multidisciplinary Minor	MDM-I	Electronic Measurement & Control System	2	2	-	-	-	-	50	-	-	50
24ETCU6E07	Professional Elective	PEC-2	Power Electronics	4	4	-	-	20	30	50	-	-	100
24ETCU6E08			CMOS VLSI design										
24ETCU6E09			Wireless Sensor Network										
24ETCU6E10		PEC-3	Cellular and Mobile Communication	3	3	-	-	20	30	50	-	-	100
24ETCU6E11			Fiber Optic Communication										
24ETCU6E12			Microwave Theory										
24ETCU6E13	Professional Elective Lab	PEC-3 Lab	Cellular and Mobile Communication Lab	1	-	2	-	-	-	-	25	-	25
24ETCU6E14			Fiber Optic Communication Lab										
24ETCU6E15			Microwave Theory Lab										
24ETCU6N16	Vocational Skills Enhancement Course	VSEC	Data Structures & Algorithms using C++	2	1	2	-	25	-	-	-	25	50
24ETCU6D17	Mandatory Course	MC	Finishing School Training VI	Audit	3*	-	-	50	-	-	-	-	Grade
24ETCU6C18	Co-Curricular Activities	CCA	Liberal Learning-VII	Audit	2#	-	-	50	-	-	-	-	Grade
24ETCU6C19			Liberal Learning-VIII										
			Total	**22**	**18**	**8**	**-**	**225**	**150**	**300**	**75**	**75**	**725**
24ETCU6H20	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- III Digital IC Design	3	2	-	-	20	30	50	-	-	100
24ETCU6H21	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper- III Digital IC Design lab	1	-	2	-	-	-	-	25	-	25

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T.Y B.Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y.B Tech, Semester-VI
Course Code and Course Title			**24ETCU6P01, Microprocessor and Microcontroller**
Prerequisite/s			Digital Electronics / Digital Logic Design, Microprocessors and Microcontrollers, C Programming / Structured Programming, Basic Electronics
Teaching Scheme: Lecture/Tutorial/Practical			**03/00/00**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	Total		**100**

Course Description: This course introduces the fundamental concepts and architecture of microprocessors and microcontrollers, with a particular focus on their applications in embedded systems. Students will explore the internal structure, instruction sets, and programming techniques of popular processors such as the Intel 8085 and microcontrollers like the 8051. The course covers hardware interfacing, memory organization, and input/output operations, enabling students to develop basic embedded applications.

Course Objectives:

1	To understand the architecture and functionalities of microprocessors and microcontrollers.
2	To gain knowledge of machine language programming and interfacing techniques.
3	To design and develop microprocessor/microcontroller-based systems for real-time applications.
4	To explore basic peripheral devices and their interfacing methods.

Course Outcomes (COs):
At the end of the course, the student will be able to:

Upon successful completion of this course, the student will be able to	
1.	Understand 8085 microprocessor architecture, operations, and basic interfacing techniques.
2.	Develop 8085 assembly language programs using data transfer, arithmetic, logic, and control operations.
3.	Explain 8086 microprocessor architecture and interface peripheral devices using standard controllers.
4.	Understand the architecture, memory, and I/O structure of the 8051 microcontroller.
5.	Write and execute 8051 assembly programs and interface it with external devices for embedded applications..

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	-	-		-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**UNIT I: INTRODUCTION TO MICROPROCESSOR**: Microprocessor architecture and its operations, Memory, Input & output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, Interfacing output displays, Interfacing input devices, Memory mapped I/O.	7
2	**UNIT II: BASIC PROGRAMMING CONCEPTS**: Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts.	8
3	**UNIT III: 16-BIT MICROPROCESSORS (8086):** Architecture, Pin Description, Physical address, segmentation, memory organization, Addressing modes. Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C	5
4	**UNIT IV: 8051 MICROCONTROLLER BASICS:** Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing with External ROM And RAM. 8051 Addressing Modes.	6
5	**UNIT V: INSTRUCTION OF 8051**: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 Timers	7
6	**UNIT VI: ASSEMBLY PROGRAMMING:** Serial Port Programming, Interrupts Programming, Interfacing: LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation	6

Text Books:

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1.	Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar,Penram International Publication (India) Pvt
2.	Microprocessors Interfacing, D. V. Hall, TMH
3.	The 8051 Microcontroller and Embedded Systems using Assembly and C, Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D, Pearson Education India

Reference Books:

1.	Microprocessors and programmed Logic, Kenneth L. Short, Pearson Education Inc
2.	8051 Microcontrollers MCS 51 Family and its Variants, Shah Satish,Oxford

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T.Y B. Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y.B Tech, Semester-VI
Course Code and Course Title			**24ETCU6P02, Digital Signal Processing**
Prerequisite/s			Applied Mathematics, Signal & Systems
Teaching Scheme: Lecture/Tutorial/Practical			**03/00/00**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	Total		**100**

Course Description: This course provides an in-depth understanding of Digital Signal Processing (DSP) concepts, including time and frequency domain analysis, filter design, and modern signal processing techniques. Emphasis is placed on practical tools like FFT, digital filters, and their implementation in real-world applications.

Course Objectives:

1	To explain the fundamental concepts of digital signals, systems, and DSP system architectures.
2	To develop an understanding of Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), and their applications.
3	To teach design techniques for Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) digital filters.
4	To familiarize students with various filter realization structures and implementation issues.
5	To introduce modern digital signal processing topics such as DSP processors, multirate signal processing, and wavelet transform.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1.	Describe digital signals, systems, and properties of DSP systems, including system responses and transfer functions
2.	Explain Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms, and related convolution methods.
3.	Analyze and design IIR filters using impulse invariant and bilinear transformation techniques.
4.	Analyze and design FIR filters using windowing methods and frequency sampling techniques.
5.	Explain filter realization structures, including direct form, cascade, and parallel forms, along with implementation challenges.
6.	Understand the architecture and programming of digital signal processors and apply concepts of multirate processing and wavelet transforms

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO6	3	2	3	2	2	-	-	-	-	-	-	-	-	-

Unit	Course Contents:	Hrs.
1	**UNIT I: DIGITAL SIGNALS AND SYSTEMS** DSP system concept. Properties of DSP system, types of system, Some elementary signals and their responses Interconnection of DSP systems. Digital transfer function and response to different inputs.	8
2	**UNIT II: THE DISCRETE FOURIER TRANSFORM AND FAST FOURIER TRANSFORM** DFT, Relation between DFT & Z ¬transform, Linear convolution, Circular convolution and DFT, FFT Algorithms, (DIT- FFT & DIF-FFT). Overlap save algorithm, overlap add algorithm	8
3	**UNIT III: IIR FILTER DESIGN** Filter design using impulse invariant technique, Bilinear transformation, Analog filter approximation (Butterworth) quantization.	6
4	**UNIT IV: FIR FILTER DESIGN** Characteristics of FIR filter, Properties of FIR filter, Fourier , digital N/W for FIR filter, frequency sampling, Fourier series method, Windowing method, Filter design using window, Filter design using Kaiser window, Hanning, Hamming, Blackman	8
5	**UNIT V: REALIZATION OF FILTERS** Filter categories, Direct form structures, cascade, parallel realization, and Implementation and Realization issues.	6
6	**UNIT VI: MODERN DIGITAL SIGNAL PROCESSING** Digital Signal Processors- Introduction, Architecture, important blocks, Programming Aspects,Multirate Signal Processing And Wavelet Transform, Introduction and applications.	6

Text Books:

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1.	Digital Signal Processing Principles, Algorithms and Applications, John G, Proakis, Pearson Education
2.	Digital Signal Processing, Sanjeet Mitra, TMH Pub.
3.	Digital Signal Processing, Dr P Ramesh Babu, Scitech Publications

Reference Books:

1.	Discrete Time Signal Processing, Oppenheim and R. W. Schafer, PHI Pub.
2.	Digital Signal Processors, Venkatramani, Bhaskar, TMH Pub.
3.	Wavelet Transform, Raghuveer Rao, Bopardikar, Pearson Education

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T.Y B.Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6P03, Computer Architecture and Organization**
Prerequisite/s			A strong foundation in basic calculus (differential and integral) and vector algebra is essential.
Teaching Scheme: Lecture/Tutorial/Practical			**02/00/00**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description: This course provides a comprehensive understanding of the internal organization, functioning, and design of computer systems. Students will explore the architecture of digital computers, including data representation, arithmetic operations, control logic, memory systems, CPU design, and input/output organization. The course also covers performance evaluation, instruction cycle design, and advanced concepts like pipelining and multiprocessor systems. Through theoretical knowledge and conceptual frameworks, students gain the ability to understand, analyze, and evaluate computer architectures and their components.

Course Objectives:

1	To introduce the basic building blocks of computer systems, including functional units, data representation, and computer arithmetic.
2	To explain register-level operations, instruction cycles, and the design of a basic computer using RTL and micro-operations.
3	To study the architecture of CPUs, instruction formats, addressing modes, and control unit design approaches.
4	To provide insights into memory hierarchy, cache organization, I/O techniques, and advanced processing concepts like pipelining.

Course Outcomes (COs):
At the end of the course the student will be able to:

1.	Understand the fundamental components of computer systems, data representation formats, and arithmetic operations used in computing.
2.	Apply register transfer language and control logic to design and analyze instruction cycles and micro-operations in basic computers.
3.	Analyze CPU architecture, addressing modes, and control unit design using both hardwired and microprogrammed techniques.
4.	Evaluate memory systems, I/O interfacing methods, and pipelining techniques to improve system performance

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-					2	1
CO2	3	3	2	2	1	1	1	-					2	1
CO3	3	3	2	2	2	1	1	-					2	1
CO4	3	2	3	1	3	1	1	-					2	1

Content	Hrs.
UNIT I: COMPUTER BASICS AND ARITHMETIC Functional units of a computer, basic operational concepts, bus structures Software and performance evaluation, multiprocessors and multi computers Data representation: signed numbers, fixed and floating point representation Computer arithmetic: Addition, subtraction, multiplication, and division algorithms Error detection and correction codes	6
UNIT II: MICRO-OPERATIONS AND BASIC COMPUTER DESIGN Register Transfer Language (RTL), registers, bus and memory transfer Micro-operations: Arithmetic, logic, shift operations, arithmetic logic unit (ALU) Basic computer organization: registers, instruction cycle, types of instructions Control logic: timing and control, memory reference, I/O, and interrupt instructions	7
UNIT III: CPU AND CONTROL UNIT DESIGN CPU organization: General and stack-based, instruction formats, addressing modes Data transfer, manipulation, and program control CISC vs RISC architectures Control unit design: Hardwired vs microprogrammed, control memory, address sequencing	7
UNIT IV: MEMORY AND I/O ORGANIZATION Memory organization: RAM, ROM, associative memory, address mapping Cache memory: mapping techniques, replacement policies, write policies Auxiliary memory: magnetic storageI/O organization: I/O subsystems, device interfaces, SCII, USBI/O transfers: programmed I/O, interrupt-driven I/O, DMA Pipelining and vector processing: concepts, throughput, hazards, speedup	6

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Text Books:

1	Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill
2	– M.Moris Mano, IIIrd Edition, Pearson/PHI
3	Architecture and Organization", 3rd Edition by John P. Hayes,WCB/McGraw- Hill

Reference Books:

1	Computer Organization and Architecture: Designing for Performance", 10th Edition by i. William Stallings, Pearson Education.
2	"Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry

	Useful Links
1	https://archive.nptel.ac.in/courses/108/106/108106073/
2	https://archive.nptel.ac.in/courses/108/104/108104099/

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T.Y B.Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6P04, Microprocessor and Microcontroller Lab**
Prerequisite/s			Digital Electronics / Digital Logic Design, Microprocessors and Microcontrollers, C Programming / Structured Programming, Basic Electronics
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**00/00/00**	**ISE / MSE / ESE**	**00/00/00**
	25/00/25	**INT / OE/POE**	**25/00/25**
	50	**Total**	**50**

Course Description: This lab course provides hands-on experience with microcontroller-based programming and interfacing using the 8051 microcontroller. students will learn to implement embedded C programs for I/O device control, signal generation, and data acquisition systems.

Course Objectives:

1	To develop embedded C programming skills for arithmetic, data transfer, and I/O control operations.
2	To enable students to interface peripherals such as LEDs, switches, LCDs, 7-segment displays, ADC, DAC, and stepper motors with 8051.
3	To demonstrate the use of microcontroller ports, timers, and interrupts in real-time scenarios.
4	To provide practical experience in waveform generation using DAC interfacing.
5	To enhance students' understanding of microcontroller simulation tools like Keil or MicroProC IDE.

Course Outcomes (COs):

After successful completion of this course, the student will be able to:	
1.	Write and execute embedded C programs for performing arithmetic operations and data transfer using 8051 microcontroller.
2.	Interface and control basic I/O devices such as LEDs, switches, and 7-segment displays using microcontroller ports.
3.	Interface and program input/output peripherals such as LCDs, keyboards, ADCs, and DACs with 8051 microcontroller.

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4.	Generate various analog waveforms and control electromechanical devices like stepper motors using embedded C programming.
5.	Simulate, test, and verify embedded system programs using industry-standard tools like Keil IDE or MicroProC.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	2	3	-	-	-	-	-	-	-	-	-
CO4	3	2	3	2	3	-	-	-	-	-	-	-	-	-
CO5	3	-	-	3	3	-	-	-	-	-	-	-	-	-

List of Experiments:

Expt. No.	Title of Experiment
1	Execute an ALP on 8085 Trainer Kit to perform 8-bit addition and subtraction of two numbers.
2	Execute an ALP on 8085 Trainer Kit to perform 16-bit addition and subtraction of two numbers.
3	Execute an ALP on 8085 Trainer Kit to perform multiplication and division of 8-bit numbers using register pair operations.
4	Execute an ALP on 8085 Trainer Kit to generate a square waveform using interfacing techniques.
5	Execute an ALP on 8086 Trainer Kit to perform 16-bit addition of two numbers.
6	Develop and execute a C language program using 8051 Development Kit for addition and subtraction of 8-bit numbers.
7	Develop and execute a C language program using 8051 Development Kit for interfacing an LCD display.
8	Develop and execute a C language program using 8051 Development Kit for LED interfacing and control.
9	Develop and execute a C language program using 8051 Development Kit for interfacing a seven-segment display.
10	Develop and execute a C language program using 8051 Development Kit for DC motor interfacing and control.
11	Develop and execute a C language program using 8051 Development Kit for stepper motor interfacing and control.
12	Develop and execute a C language program using 8051 Development Kit for interfacing an 8-bit DAC to generate analog output signals.

All experiments should be performed from the above list.

Text Books:

1	Embedded System - Architecture Programming and Design, P.Raj Kamal,McGraw Hill Education
2	Introduction to Embedded Systems, Shibu. K.V, McGraw Hill Education India Private Limited
3	Embedded Systems-An Integrated Approach, Lyla B Das, Pearson Education India
4	Embedded / Real-Time Systems: Concepts, Design and Programming, Prasad K. V. K. K., Dreamtech Press India Pvt. Ltd
5	Embedded Systems : A contemporary Design Tool, James K Peckol,John Wiley & Sons
6	Fundamentals of Embedded Software, Daniel W Lewis, Prentice-Hall of India Pvt. Ltd

Reference Books:

1	Embedded System Design: A Unified Hardware/Software Introduction, Frank Vahid and Tony Givargis, John Wiley & Sons
2	Computers as Components: Principles of Embedded Computing System Design, Wyne Wolf , Wiley India Pvt. Ltd
3	Embedded Systems Architecture, Tammy Noergaard, Newnes
4	An Embedded Software Primer, David E. Simon, Pearson Education India

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6P05, Digital Signal Processing Lab**
Prerequisite/s			Applied Mathematics, Signal & Systems
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**00/00/00**	**ISE / MSE / ESE**	**00/00/00**
	25/00/25	**INT / OE/POE**	**25/00/25**
	50	**Total**	**50**

Course Description: This lab course provides hands-on experience in implementing digital signal processing concepts using MATLAB and DSP kits. Students perform experiments involving signal generation, transform computation, filter design, and real-time DSP processor applications to strengthen theoretical knowledge through practical application.

Course Objectives:

1	Develop basic knowledge of DSP systems and signal processing techniques through practical experiments.
2	Understand and implement FFT and filter design methods in a lab environment.
3	Gain proficiency in using modern signal processing tools and DSP kits for real-time applications.
4	Apply multirate signal processing concepts such as upsampling and downsampling in practical scenarios.
5	Implement and analyze DSP processor functions like convolution, difference equations, and filter operations.

Course Outcomes (COs):

After successful completion of this course, the student will be able to:

CO1	Apply signal processing tools and transforms for discrete-time signals.
CO2	Design and implement IIR and FIR filters using MATLAB and DSP kits.
CO3	Explain and demonstrate modern DSP tools and algorithms in real-time applications.
CO4	Perform multirate signal processing including upsampling, downsampling, and filtering effects.
CO5	Implement DSP processor functionalities such as convolution, difference equations, and filter implementation.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-	-	-

List of Experiments

List of Lab Activities: Minimum 10-12 experiments using Matlab and DSP kit with reference to following list-

Expt. No.	Title of Experiment
1	Generation and convolution of DT signals.
2	Digital frequency and aliasing effect in sampling.
3	Frequency response and magnitude, phase plot of system.
4	Response of system to standard test signals.
5	DFT and IDFT computation and magnitude, phase plot.
6	Circular convolution and comparison with linear convolution.
7	IIR filter design.
8	FIR filters design.
9	IIR and FIR filter design using toolbox.
10	Multirate signal processing-up and down sampling and Frequency domain effects.
11	Multirate signal processing- anti- imaging and antialiasing filter.
12	DSP processor- Linear and circular convolution.
13	DSP processor- Difference equation and impulse response.
14	DSP processor- Implementation of filter.

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Text Books:

1	Digital Signal Processing Principles, Algorithms and Applications, John G, Proakis, Pearson Education
2	Digital Signal Processing, SanjeetMitra, TMH Pub.
3	Digital Signal Processing, Dr P Ramesh Babu, Scitech Publications.

Reference Books:

1	Discrete Time Signal Processing, Oppenheim and R. W. Schafer, PHI Pub.
2	Digital Signal Processors, Venkatramani, Bhaskar, TMH Pub.
3	Wavelet Transform, Raghuveer Rao, Bopardikar, Pearson Education

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6M06 Electronic Measurement & Control System**
Prerequisite/s			Applied Mathematics, Signal & Systems
Teaching Scheme: Lecture/Tutorial/Practical			02/00/00
Credits			**02**
Evaluation Scheme	**00/00/50**	**ISE / MSE / ESE**	**00/00/50**
	00/00/00	**INT / OE/POE**	**00/00/00**
	50	**Total**	**50**

Course Description:

Instrumentation and control system plays the primary role in the designing of control and instrumentation-based systems. In today's telecommunication world knowing physical parameter is very important to forecast certain things, and this is possible only when we study instrumentation and control system subject. The students will learn different types of sensors and actuators, and Virtual Instrumentation along with basic concepts of control systems.

Course Objectives:

1	To explain student with different types of sensors and transducers along with working principles
2	To motivate students to study the electronic instruments & display devices
3	To motivate students to study the time domain, frequency domain and stability of LTI systems

Course Outcomes (COs):

At the end of the course the student will be able to:

1	Analyze and identify the instrument suitable for specific measurements.
2	Use and identify the basic principles of Transducers & Sensors.
3	Analyze and identify open loop & closed loop control systems.
4	Analyze the LTI system in time domain and frequency domain.
5	Test the stability of LTI system using conventional methods.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	2	-	-	2	-	-
CO2	3	2	2	2	2	1	-	-	2	-	-	1	-	-
CO3	3	2	2	2	2	-	-	-	2	-	-	1	-	-
CO4	3	2	2	2	2	-	-	-	2	-	-	1	-	-
CO5	3	2	2	2	2	-	-	-	2	-	-	1	-	-

Contents	Hours
UNIT 1: VIRTUAL INSTRUMENTATION: Introduction to virtual instrumentation, Role of Software in Virtual Instrumentation, Virtual Instrumentation with Lab VIEW, Components of Lab VIEW applications.	7
UNIT 2: INTRODUCTION OF CONTROL SYSTEM Introduction to open & close loop control systems, advantages, disadvantages & applications, Transfer function concepts, Block diagram algebra, and Signal flow graphs. Illustrative examples	9
UNIT 3: TIME AND FREQUENCY RESPONSE ANALYSIS Introduction, Standard test signals, Time response of first and second order systems for standard test inputs Performance indices, Frequency response of second order systems, bode plots, Assessment of relative stability–Gain Margin and Phase Margin, Illustrative examples.	8
UNIT 4: STABILITY ANALYSIS Concept of Stability in S domain, Classification of Stability, stability analysis by Hurwitz criterion and Routh array, determining range of K for stable operation. Illustrative examples.	6

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Text Books:

1.	Sawhney A.K., Electrical and Electronics Measurements and Instruments, Dhanpat Rai&Co.02ndEd.
2.	W. D. Cooper & A. D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI, 4the/d,1987.
3.	David Bell,' Electronic Instrumentation and Measurements',PHI,2e/d Ogata Katsuhiko,"Modern Control Engineering",5thEdition,PHI
4.	NagrathI. J. and M.Gopal, "Control Systems Engineering",6th edition, New Age international
5.	Dr.S.D.Bhide, R.A.Barapate, "Feedback Control Systems", 9th Revised Edition, Tech. Max Publications.
6.	Ramesh Babu, R. Ananda Natarajan, "Control System Engineering", SCITECH Publications

Reference Books:

1.	Hewlett Packard, Tektronics, Advantest, Aplab,"Application Notes on Measurement".
2.	BouwensA.J., "Digital Instrumentation", McGraw-Hill, second edition.

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Semester-VI

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ETCU6E07, Power Electronics**
Prerequisite/s			Analog and Digital Circuits
Teaching Scheme: Lecture/Tutorial/Practical			**04/00/00**
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**ISE / ESE**	**00/00**
		Total	**100**

Course Description: Power Electronics is a course that explores the principles and applications of electronic devices and circuits used for power conversion and control. It covers topics such as rectifiers, inverters, converters, and their applications in industries, providing students with the knowledge to design and implement efficient power electronic systems

Course Objectives:

1	This course intends to provide basic knowledge of different power electronic devices, rectifiers, converters, inverters and choppers.
2	It is aimed to impart skills of analysis for different types of converters such as rectifiers, controlled converters, inverters and choppers.
3	Make the students acquainted with design of different types of converters such as rectifiers, controlled converters, inverters, choppers and their associated control circuit.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Describe the basics of semiconductor switches, rectifier, control converter, inverter, choppers, and cyclo-converter and matrixconverter circuits.
2	Calculate the performance of semiconductor switches, rectifier,converter, inverter, choppers, and cyclo-converter and matrix converter circuits.
3	Analyze the Power Electronic Circuits such as rectifier, converter, inverter, choppers, and cyclo-converter and matrix converter circuits.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-

Content	Hrs.
UNIT I: POWER SEMICONDUCTOR SWITCHES: Characteristics of ideal switch, V-I Characteristics, Rating, protection and cooling of power semiconductor devices such as power diodes, transistor,MOSFET, IGBT and GTO, Study of the driver circuits for thyristor, GTO and IGBT, Introduction to smart power modules, Comparative study of MOSFET, thyristor, GTO, BJT and IGBT.	6
UNIT II: SINGLE PHASE AND THREE PHASE AC TO DC RECTIFIERS Single phase half wave and single-phase full wave diode bridge. Three phase half wave and three phase full wave diode bridge, Transformer power rating for above configurations. Source current and output voltage analysis.	6
UNIT III: PHASE CONTROLLED AC TO DC CONVERTERS Classification of converters, Single phase half controlled and fully controlled thyristor converters, three pulse and six pulse controlled converters, operation of converter with freewheeling diode. Effect of source inductance on the performance of the converter, overlap – angle. Performance factors for the converter such as displacement factor, distortion factor, total harmonic distortion, ripple factor and transformer utilization factor. Introduction to 12 pulse converter, single phase and three phase dual converter, firing scheme for 1 phase and three phase converter, Brief introduction to commutation methods. Introduction to PWM converters.	8
UNIT IV: DC TO DC CONVERTERS Control of DC-to-DC converters, step down (buck) converter, Analysis of buck converter with RLE load, step up converter, buck – boost converter, full bridge DC to DC converter, concept of multiphase choppers, cuk converter.	6
UNIT V: SWITCH MODE DC – AC INVERTERS Basic concepts of switch mode inverters, types: VSI and CSI, single phase half bridge and full bridge inverter, three phase six step inverter, 1200 mode of conduction, 1800 mode of conduction, three phase PWM Inverter, sinusoidal PWM and selective harmonics elimination methods of PWM. Effect of blanking time on output voltage in PWM inverters, auto sequentially commutated CSI, Solar Inverters, Introduction to multilevel inverters.	7
UNIT VI: CYCLOCONVERTERS AND MATRIX CONVERTER Introduction to Single phase and three phase cycloconverters. Working and topologies of Matrix converter, control methods, performance analysis of matrix converter.	6

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Text Books:

1	M. H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 4th Edition, November 2017.
2	P. S. Bhimra, "Power Electronics",3rd Edition, Khanna Publishers, 2002.

Reference Books:

1	B.K. Bose, "Modern Power Electronics and A.C. Drives", Prentice Hall of India Pvt. Ltd. Publication, 2002.
2	Mohan, UndelandRobins, "Power Electronics, Converter Applications and Design", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3	G. K. Dubey and Others "Thyristorised Power Controller", New Edge International Publishers, 1st Edition Reprint, 2005.

Useful Links	
1	NPTEL lectures on Power Electronics

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E08 CMOS VLSI design**
Prerequisite/s			Basics of semiconductor
Teaching Scheme: Lecture/Tutorial/Practical			**04/00/00**
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description: This course covers the principles and techniques of CMOS VLSI design. It emphasizes
the design and analysis of CMOS logic gates, circuit layout, static and dynamic characteristics, and performance
metrics. The course also introduces layout design rules, scaling issues, and CAD tools for VLSI design. It aims to provide both theoretical knowledge and practical skills in CMOS circuit design.

Course Objectives:

1	To understand the fundamentals of MOS transistors and their characteristics in VLSI circuits.
2	To study CMOS fabrication processes and layout design rules.
3	To analyze and design static and dynamic CMOS logic circuits.
4	To introduce subsystem design and optimization techniques for CMOS circuits.

Course Outcomes (COs):
At the end of the course, the student will be able to:

1	Explain MOSFET operation, capacitance models, and parasitics in VLSI circuits.
2	Analyze delay, power dissipation, and performance dependencies in CMOS circuits.
3	Estimate delays and parasitic effects in logic gates and multistage networks.
4	Design and analyze static CMOS combinational logic and identify hazards.
5	Design and analyze sequential circuits and explore various CMOS circuit families.
6	Discuss low power and high-speed design techniques, advanced materials, and design margins.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	2	1	-	-	2	1
CO2	3	3	2	2	3	-	-	-	2	-	1	-	2	1
CO3	3	3	2	2	2	2	1	1	2		2	2	2	2
CO4	3	3	2	2	3	-	-	2	1	2	2	2	2	2
CO5	3	3	2	2	3	-	-	2	2	2	2	2	2	2
CO 6	3	3	2	3	3	-	1	-	-	1	2	3	-	-

Content	Hrs.
UNIT I: INTRODUCTION TO MOSFETS AND CMOS INVERTER: Structure, operation, static & dynamic characteristics, noise margins. MOS capacitance models, MOS gate capacitance model, MOS diffusion capacitance model. Non-ideal I-V effects, MOSFET equivalent circuits and analysis, parasitics; technology scaling; lambda parameter; wiring parasitics.	7
UNIT II: PERFORMANCE PARAMETERS: Static, dynamic and short circuit power dissipations. Propagation delay, power delay product, fan-in, fan-out and dependencies. Delay estimation: RC delay models, linear delay model, logical effort, parasitic delay.	5
UNIT III: LOGICAL EFFORT AND TRANSISTOR SIZING: Delay in a logic gate, delay in multistage logic networks. Interconnect: resistance, capacitance, delay, crosstalk. Design margin considerations.	5
UNIT IV: LOGIC DESIGN: STATIC CMOS LOGIC: inverter, NAND gate, NOR gate, compound gates, pass transistors and transmission gates, tristates, multiplexers, latches and flip-flops. Design calculations for combinational logic and active area on chip; hazards, sources and mitigation techniques.	7
UNIT V: SEQUENTIAL CIRCUIT DESIGN & CIRCUIT FAMILIES: Latches, flip-flops, registers, dynamic storage elements. Circuit families: static CMOS, ratioed circuits, cascode voltage switch logic, dynamic circuits, domino logic, NORA logic, differential circuits, sense amplifier circuits, BiCMOS circuits.	5
UNIT VI: ADVANCED TOPICS: Low power logic design, comparison of circuit families, materials for performance improvement, techniques for low power and high-speed designs.	7

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Text Books:

1	Charles H. Roth, "Digital Systems Design using VHDL", 2 nd Edition, Thompson Learning
2	Wyane Wolf, "Modern VLSI Design (IP-Based Design)", 4th Edition, Prentice Hall
3	Steve Kilts, "Advanced FPGA Design Architecture, Implementation and Optimization" Wiley Interscience.
4	E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", 4 th Edition, Pearson Publication

Reference Books:

1	R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 3rd Edition, Wiley-IEEE Press.
2	John F. Wakerly, "Digital Design Principles and Practices", 3rd Edition, Prentice Hall.
3	M. Morris Mano , "Digital Design", 3rd Edition , Pearson.
4	Cem Unsalan, Bora Tar, "Digital System Design with FPGA: Implementation Using Verilog and VHDL", McGraw-Hill. MOOC /.

Useful Links	
1	NPTEL Course on "VLSI Technology", By Dr. Nandita Dasgupta, IIT Madras Link: https://nptel.ac.in/courses/117106093

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E09, Wireless Sensor Network**
Prerequisite/s			Basic concepts on Data Communications and Networking.
Teaching Scheme: Lecture/Tutorial/Practical			**04/00/00**
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description: This course introduces the fundamentals of Wireless Sensor Networks, covering sensor node architecture, MAC and routing protocols, network security, and data communication techniques. It emphasizes energy efficiency, secure data transmission, and system integration in real-world WSN applications.

Course Objectives:

1	To introduce the basics and types of wireless sensor networks.
2	To explain sensor node hardware and system architecture.
3	To study MAC protocols used in WSNs.
4	To understand routing techniques and gateway concepts.
5	To explore security issues and solutions in WSNs.
6	To learn data communication and aggregation methods.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Identify types and applications of WSNs.
2	Describe sensor node components and energy use.
3	Compare different MAC protocols in WSNs.
4	Explain routing protocols and gateway design.
5	List security threats and secure routing methods.
6	Apply data aggregation and QoS techniques in WSNs.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	-	-	2	-	-	-	-	-	-	-	3	3
CO3	3	2	2	-	2	-	-	-	-	-	-	-	3	3
CO4	3	2	2	-	2	-	-	-	-	-	-	-	3	3
CO5	3	2	2	2	-	-	-	2	-	-	-	-	3	3
CO6	3	3	2	2	2	-	-	-	-	-	-	-	-	-

Content	Hrs.
UNIT I: INTRODUCTION TO SENSOR NETWORKS Introduction to Wireless Sensor Node, Anatomy of a Sensor Node, Architecture of WSN, Performance metrics/ Figures of Merit in WSN, Types of WSN, WSN application examples,	6
UNIT II: HARDWARE AND SYSTEM ARCHITECTURE OF WSNS Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes,Transceiver Design Considerations ,Design Constraints for Sensor Nodes ,Operating Systems and Execution Environments, Introduction to TinyOS and nesC	10
UNIT III:MAC PROTOCOLS IN WIRELESS SENSOR NETWORKS Low Duty Cycle Protocols and Wakeup Concepts-S-MAC, The Mediation Device Protocol, Contention-Based Protocols: PAMAS ,Schedule-Based Protocols: LEACH ,IEEE 802.15.4 MAC Protocol	
UNIT IV: ROUTING PROTOCOLS IN WSNS Introduction to Routing in WSNs, Energy-Efficient Routing Techniques, Hierarchical and Flat Routing Protocols,Gateway Concepts and Design,WSN to Internet Communication, Internet to WSN Communication	10
UNIT V: SECURITY IN WIRELESS SENSOR NETWORKS Security Requirements and Challenges in WSNs,Layer-wise Security Threats,Network Security Attacks: Jamming, Tampering, Black Hole, Flooding,Key Distribution and Management,Secure Routing Protocols: SPINS, Reliability and Resilience in WSNs	8

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UNIT VI: DATA COMMUNICATION AND AGGREGATION IN WSNS	8
Data-Centric Communication,In-Network Processing,Data Aggregation Techniques,Data Compression Methods,Traffic Patterns in WSNs (event-driven, continuous, query-based),Quality of Service (QoS) Considerations	

Text Books:

1	Holger Karl, Andreas Willig, "Protocols and Architectures For Wireless Sensor Networks", ISBN: 0-470-09510-5 2.
2	Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks", ISBN 978-0-470-99765-9
3	Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby, Daniel Minoli, Taieb Znati

Reference Books:

1	Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, ISBN 9780849318238
2	Anna Hac, "Wireless Sensor Network Designs," John Wiley & Sons, ISBN 0-470- 86736-1
3	Robert Faludi, "Building Wireless Sensor Networks:A Practical Guide to the ZigBee Mesh Networking Protocol" , Shroff Publishers, ISBN: 9789350232897

Useful Links	
1	8 WEEK NPTL Course WIRELESS AD HOC AND SENSOR NETWORKS by Prof. Sudip Misra Department Of Computer Science IIT Kharagpur ,https://archive.nptel.ac.in/courses/106/105/106105160/

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T.Y B.Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E10, Cellular & Mobile Communication**
Prerequisite/s			A fundamental understanding of analog and digital communication principles is essential.
Teaching Scheme: Lecture/Tutorial/Practical			**03/00/00**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description: This course provides foundational to advanced knowledge of cellular and mobile communication systems, covering technologies from 1G to 5G. It emphasizes system architecture, propagation models, multiple access techniques, and emerging technologies like LTE-Advanced and 5G NR, with practical exposure through simulations and trainer kits.

Course Objectives:

1	To impart fundamental understanding of cellular communication concepts.
2	To develop analytical insights into radio wave propagation mechanisms.
3	To familiarize students with the evolution of mobile technologies.
4	To build competence in modern multiple access and transmission techniques.

Course Outcomes (COs):

At the end of the course the student will be able to:

1	Explain the fundamental cellular concepts.
2	Analyze the impact of large-scale and small-scale propagation effects on signal transmission in mobile environments.
3	Compare various multiple access techniques and classify the characteristics of circuit-switched and packet-switched data services.
4	Summarize the architectural and technological evolution from 1G to 3G systems
5	Illustrate the LTE system architecture
6	Demonstrate an understanding of 5G architecture.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	3	2	1	-	-	-	-	-	-	2	2	3
CO2	3	3	3	3	2	-	-	-	-	-	-	2	2	3
CO3	3	3	3	-	2	-	-	-	-	-	-		2	3
CO4	2	2	3		3	-	-	-	-	-	-			3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO6	3	3	3	3	3	-	-	-	-	-	-	2	2	3

Content	Hrs.
UNIT I: CELLULAR CONCEPTS Cellular system, Hexagonal Geometry Cell, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Distance to Frequency Reuse Ratio, Interference & System Capacity, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems -Cell Splitting, Cell Sectorization, Repeaters, Micro Cell Zone Concept	7
UNIT II: MOBILE RADIO PROPAGATION: LARGE SCALE FADING Path Loss Free Space propagation model, Relating Power to Electric Field, The three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two Ray) Model, Diffraction, Scattering, Small-Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of small-Scale Fading.	7
UNIT III- MOBILE COMMUNICATION FUNDAMENTALS & MULTIPLE ACCESS TECHNIQUES Mobile and Personal Communication, mobile and wireless devices, Specialized packet and mobile radio networks, Circuit switched data services on cellular networks, packet switched data services on cellular networks, Multiplexing: FDD and TDD schemes. Multiple Access techniques: TDMA, FDMA, SDMA, OFDMA.	7
UNIT IV: EVOLUTION OF MOBILE COMMUNICATION SYSTEMS Brief Introduction to First Generation (1G) Mobile Systems, Second Generation Mobile Systems: GSM System Architecture, GSM Channels, Second Generation Mobile Systems CDMA (IS-95): CDMA Architecture and Air Interface, CDMA Forward and Reverse Channels Third Generation Mobile Systems IMT-2000: Introduction to 3G Standards and IMT-2000 Framework, Forward and Reverse Channels in W-CDMA and CDMA-2000	7
UNIT V: EVOLVING TO 4G-LTE 3G Limitations and the need for LTE, Overview of 4G LTE and its key features, LTE Architecture (E-UTRAN and EPC), LTE Frequency Bands and Spectrum Allocation LTE Channels (Physical and Logical), Handover in LTE, Introduction to LTE-Advanced features (Carrier Aggregation, etc.)	7

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UNIT VI: 5G AND BEYOND Overview of 5G requirements and use cases (eMBB, URLLC, mMTC), 5G Architecture (NG-RAN and 5G Core - high-level overview), Spectrum sharing for 5G (DSS), 5G System concepts (Beamforming, Network Slicing, Edge Computing), Single and multi-user MIMO in 5G (and massive MIMO), Key features and potential of 6G (brief overview of research areas)	7

Text Books:

1	Lee, W. C. Y. (Latest Edition). Mobile Cellular Telecommunications. McGraw-Hill.
2	Rappaport, T. S. (Latest Edition). Wireless Communications: Principles and Practice. Prentice Hall.
3	Holma, H., & Toskala, A. (Latest Edition). LTE for UMTS: OFDMA and SC-FDMA Based Radio Access. Wiley.

Reference Books:

1	Sheikh, A. U. H. (2004). Wireless Communication Theory and Techniques. Springer.
2	Stuber, G. L. (2001). Principles of Mobile Communications (2nd ed.). Springer International.
3	Haykin, S., & Moher, M. (2005). Modern Wireless Communication. Pearson Education.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E11 Fiber Optic Communication**
Prerequisite/s			Digital and Analog Communication systems, and Electronic devices.
Teaching Scheme: Lecture/Tutorial/Practical			**03/00/00**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description: This course introduces fiber optic communication systems' fundamental principles and applications. It covers the structure and properties of optical fibers, light propagation, sources and detectors, modulation techniques, and system design, emphasizing modern telecommunication and data transmission technologies.

Course Objectives:

1	Describe the basics of optical communication along with simulation and modeling the same with Blocks.
2	Explain optical fiber structure and light propagating mechanisms in detail.
3	Analyze the signal degradation mechanisms and the methods of limiting.
4	Explain the construction and working of optical sources and detectors.

Course Outcomes (COs):
At the end of the course, the student will be able to:

1	Elaborate the basic optical communication along with the simulation and modeling tools.
2	Differentiate the different types of optical fiber structures and light propagating mechanisms.
3	Understand the basics of the signal degradation mechanism in optical fiber.
4	Understand the construction and working of optical sources and detectors.
5	Describe the optical receiver operation, WDM, and optical network in detail
6	Analyze the principles and performance of WDM networks, tunable devices, SONET/SDH, EDFA integration, and optical CDMA applications.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	1	1	2	1	-
CO2	3	3	1	2	2	-	-	-	-	1		2	1	1
CO3	3	3	-	3	2	-	1	-	-	1		2	2	2
CO4	3	2	-	2	2	-	-	-	-	1		2	3	-
CO5	3	3	2	2	2	-	1	-	-	1	1	2	-	-
CO6	3	3	2	3	3	-	1	-	-	1	2	3	-	-

Content	Hrs.
UNIT I: OVERVIEW OF OPTICAL FIBER COMMUNICATION Motivation for light wave communication, Basic Network Information Rates, The evolution of Optic System, Elements of Optical Fiber Transmission Link, optical spectral band, The nature of Light, Basic Optical Laws and Definitions, Single Mode Fibers, Graded Index fiber structures.	7
UNIT II: OPTICAL FIBERS: STRUCTURES, WAVE GUIDING AND FABRICATION Optical Fiber Modes and Configurations, Mode theory for waveguides, Fiber Materials, Fiber Fabrication, Fiber Optic cables.	5
UNIT III: TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS. Attenuation, material absorption losses, scattering losses, bending losses, dispersion, polarization, nonlinear effects.	5
UNIT IV: OPTICAL SOURCES Semiconductor Physics, Light-Emitting Diodes (LEDs),Laser Diodes, Light Source Linearity, Modal, Partition and Reflection Noise, Reliability Considerations.	7
UNIT V: OPTICAL RECEIVER Physical Principal of Photodiodes, Photo detector Noise, Detectors Response Time, Avalanche Multiplication Noise, Structure for InGaAsAPDs, Temperature effect of Avalanche Gain, Comparison of Photo detectors , Fundamental Receiver Operation, Digital Receiver Performance, Detailed Performance Calculations	8
UNIT V: OPTICAL NETWORKS Operational Principles of WDM, Passive Components, Tunable Sources, Tunable Filters, Basic Networks, SONET/SDH, Broadcastand– Select WDM Networks, Wavelength Routed Networks, Nonlinear Effects on Network Performance, Performance of WDM+EDFA Systems, optical CDMA.	7

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Text Books:

1	Optical Fiber Communication–Gerd Keiser. Fifth Edition(TMH)

Reference Books:

1	Fiber optics and optoelectronics-R. P. Khare(Oxford university)
2	Optical fiber and laser principles and applications by Anuradha New Age Publications.
3	Fiber optic communication systems by Dr .R .K .Singh,Willey India.
4	Optical Communication–Senior Person

Useful Links	
1	https://www.youtube.com/watch?v=ougKUUM3hJA&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYI

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E12 Microwave theory**
Prerequisite/s			Electromagnetic theory
Teaching Scheme: Lecture/Tutorial/Practical			**03/00/00**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**00/00/00**
		Total	**100**

Course Description:
This course covers the fundamentals of microwave engineering including wave propagation, microwave components, tubes, devices, and radar systems. It emphasizes the behavior of electromagnetic waves in waveguides, analysis of microwave tubes and semiconductor devices, and their roles in radar systems. The course is designed to build oth theoretical and analytical skills necessary for microwave circuit design and high-frequency communication systems.

Course Objectives:

1	To understand the behavior and propagation of electromagnetic waves in microwave waveguides and transmission lines.
2	To study the characteristics and functions of various passive microwave components.
3	To analyze the working principles and construction of high-power microwave tubes.
4	To gain insight into modern microwave semiconductor devices and their applications.
5	To explore the operating principles and types of radar systems, including advanced techniques like Doppler and FMCW radar.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Analyze the propagation of TE, TM, and TEM modes in rectangular waveguides and calculate power transmission and losses.
2	Evaluate the characteristics and functionality of microwave components like tees, couplers, and
3	Explain the construction, working, and analytical treatment of microwave tubes including klystron, magnetron, and TWTs.
4	Describe the principles, characteristics, and applications of microwave semiconductor devices such as Gunn, IMPATT, and PIN diodes.

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5	Derive and apply radar range equations, and distinguish between different types of radar systems including Doppler, CW, and MTI radars.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	-	2	1	-
CO2	3	3	2	2	3	-	-	-	-	2	-	2	1	1
CO3	3	2	-	2	2	2	1	1	-	2	-	2	2	2
CO4	3	3	2	2	3	-	-	2	1	2	2	2	2	-
CO5	3	3	2	2	2	1	1	2	-	-	-	2	1	-
CO6	3	3	2	2	3	2	1	2	1	2	2	2	-	-

Content	Hrs.
UNIT 1: MICROWAVE WAVEGUIDES Rectangular wave guides, TE, TM and TEM modes in wave guides, power transmission in wave guide, different losses in waveguides and excitation modes in wave guides	7
UNIT II: SMART GRID TECHNOLOGIES Scattering parameters, E Plane Tee, H Plane Tee, Hybrid Tee Directional coupler. Ferrite devices, Attenuator, isolator. Slotted line and Microstrip lines	5
UNIT III: MICROWAVE MEASUREMENTS: fundamentals of power meter, transmission measurements and reflection measurements. Vector network analyzer: Basic vector measurements, architecture, calibration, material property measurements using VNA.	5
UNIT IV: MICROWAVE TUBES: Electron nature in Electromagnetic field, Klystron, Reflex Klystron, TWT's. Magnetron, forward wave cross field amplifier. (construction and analytical treatment)	7
UNIT V: MICROWAVE DEVICES: Microwave Tunnel diode, FET, RWH theory – LSA & InP diode, PIN diode, IMPATT diode, Gunn diode.	6
UNIT VI: RADAR SYSTEMS: Free space Radar range equation & other forms, Radar Beacon, Types – Monostatic, Bistatic, Doppler's radar, CW radar, MTI, FMCW.	6

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Sr.no	Tutorial Topic
1	Problems on TE, TM, and TEM modes in rectangular waveguides, and power transmission calculations.
2	Tutorial on waveguide losses and excitation modes; examples with practical waveguide parameters.
3	Calculations and examples on S-parameters, E-plane Tee, H-plane Tee, and Hybrid Tee.
4	Analysis of directional couplers, ferrite devices, and applications in microwave circuits.
5	Tutorial on microwave measurement techniques: power meter, transmission and reflection measurements.
6	Practical examples on VNA measurements, calibration and material property measurements.
7	Analysis of Klystron, Reflex Klystron, TWTs, and Magnetron structures and performance.
8	Tutorial on microwave semiconductor devices: operation and characteristics of tunnel diode, FET, PIN diode.
9	Examples of Gunn diode, IMPATT diode, and LSA & InP diode working principles and parameters.
10	Radar system performance calculations: range equations, Doppler radar principles, CW and MTI radar basics.

Text Books:

1	Samul Lion - Microwave Devices and Circuit, Prentice hall of India, 3rd edt. 2003
2	Annapurna das - Microwave Engineering, TMH Publication, 3rd edition, 2017.
3	J. D. Krause - Antenna Theory, SIE publication, 4th edition, 2017

Reference Books:

1	R.E. Collin, Foundation for Microwave Engg., Wiley Pub, 2nd edition, 2007.
2	David M. Pozar, Microwave Engineering, Wiley Pub, 4th edition, 2013.
3	M.L. Sisodia, Microwave Active Devices, New agepublisher, 1st edition, 2003.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee103/preview

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E13, Cellular & Mobile Communication Lab**
Prerequisite/s			A fundamental understanding of analog and digital communication principles is essential.
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**00/00/00**
	P	**INT / OE/POE**	**25/00/00**
		Total	**25**

Course Description: This course provides hands-on experience with the Scientech 2140 5G VoLTE Smart Phone Training System to understand the architecture, operation, and troubleshooting of modern 5G smartphones. It equips learners with practical skills in hardware analysis, signal flow study, and RF measurement using real-time test points and spectrum analysis.

Course Objectives:

1	Understand the architecture and functioning of 5G VoLTE smartphones.
2	Develop skills in identifying and analyzing major hardware sections.
3	Perform troubleshooting using simulated faults and test points.
4	Study RF signal behavior using the spectrum analyzer module.
5	Gain practical experience in signal flow and subsystem operation.

Course Outcomes (COs):
After successful completion of this course, the student will be able to:

1	Ability to explain the working and architecture of 5G VoLTE smartphones.
2	Proficiency in analyzing signal flow across major smartphone subsystems.
3	Capability to diagnose and troubleshoot hardware faults effectively.
4	Skills to measure and interpret RF signals using a spectrum analyzer.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	2	-	-	-	-	-	-	3	-	-
CO2	2	3	3	2	2	-	-	-	-	-	-	3	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-	2	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	2	-	-

List of Experiments

Expt. No.	Title of Experiment
1.	Study of 5G Smartphone Architecture and Block Diagram
2.	Analysis of Dual SIM Interface and SIM Detection Process
3.	Study of Battery Charging Circuit and Power Management Unit (PMU)
4.	Study of Touchscreen Display and Interface Signals
5.	Study of User Interface Sections: Buzzer, Vibrator, MIC, Speaker, Hands-Free
6.	Analysis of RF Section and Signal Flow in 5G Sub-6 Bands
7.	Fault Creation and Troubleshooting in Charging and PMU Section
8.	Fault Creation and Troubleshooting in Audio/MIC/Speaker Section
9.	Signal Flow Verification Using Section-wise Test Points
10.	Study of RF Signals Using USB RF Spectrum Analyzer Module

Text Books:

1	Lee, W. C. Y. (Latest Edition). Mobile Cellular Telecommunications. McGraw-Hill.
2	Rappaport, T. S. (Latest Edition). Wireless Communications: Principles and Practice. Prentice Hall.
3	Holma, H., & Toskala, A. (Latest Edition). LTE for UMTS: OFDMA and SC-FDMA Based Radio Access. Wiley.

Reference Books:

1	Sheikh, A. U. H. (2004). Wireless Communication Theory and Techniques. Springer.
2	Stuber, G. L. (2001). Principles of Mobile Communications (2nd ed.). Springer International.
3	Haykin, S., & Moher, M. (2005). Modern Wireless Communication. Pearson Education.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E14, Fiber Optic Communication Lab**
Prerequisite/s			Basic knowledge of electromagnetic waves and wave propagation
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**00/00/00**
	P	**INT / OE/POE**	**25/00/00**
		Total	**25**

Course Description: This course introduces the fundamentals of optical fiber communication and provides hands-on experience with optical components, fiber characteristics, and system performance. Students learn to analyze, measure, and evaluate optical transmission systems and modern optical networks.

Course Objectives:

1	Understand the fundamental principles of optical fiber communication systems.
2	Analyze transmission characteristics such as attenuation, dispersion, and nonlinear effects.
3	Develop skills in handling and characterizing optical sources, detectors, and fiber components.
4	Perform measurements and evaluate the performance of optical links and WDM-based networks.

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
CO1	Explain the structure, properties, and transmission principles of optical fibers.
CO2	Analyze attenuation, dispersion, and other transmission impairments in fiber-optic systems.
CO3	Demonstrate the operation and characteristics of optical sources and photodetectors.
CO4	Evaluate the performance of optical communication links and WDM optical networks.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	-
CO4	2	3	3	3	-	-	-	-	-	-	-	2	-	-

List of Experiments

Expt. No.	Title of Experiment
1	Study of Optical Fiber Properties and Identification of Fiber Types (Single-mode vs Graded-index)
2	Measurement of Attenuation in Optical Fibers (Cut-back Method)
3	Measurement of Dispersion: Chromatic and Modal Dispersion Analysis
4	Characterization of Scattering and Bending Losses in Fibers
5	Fabrication Demonstration: Fiber Drawing and Coating (or observation of fiber fabrication process)
6	LED and Laser Diode Characteristics: I–V, Output Power and Linewidth Measurement
7	Optical Source Linearity, Modal Noise and Reflection Noise Experiments
8	Photodiode & APD Characterization: Responsivity, Noise, and Response Time
9	Digital Optical Receiver Performance: BER Measurement and Receiver Sensitivity
10	WDM System Experiment: Multiplexing/Demultiplexing, EDFA Gain Measurement and Wavelength Routing Effects

Text Books:

1	Optical Fiber Communication–Gerd Keiser. Fifth Edition(TMH)

Reference Books:

1	Fiber optics and optoelectronics-R. P. Khare(Oxford university)
2	Optical fiber and laser principles and applications by Anuradha New Age Publications.
3	Fiber optic communication systems by Dr .R .K .Singh,Willey India.
4	Optical Communication–Senior Person

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Kasaba Bawada, Kolhapur
Department of Electronics and Telecommunication Engineering

T.Y B.Tech. Curriculum w. e. f. A.Y. 2026-27
(As Per National Education Policy 2020)
Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6E15, Microwave Theory Lab**
Prerequisite/s			Knowledge of transmission lines, Smith chart, and RF fundamentals
Teaching Scheme: Lecture/Tutorial/Practical			**00/00/02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**00/00/00**
	P	**INT / OE/POE**	**25/00/00**
		Total	**25**

Course Description: This course introduces microwave waveguides, components, devices, and measurement techniques, along with radar system fundamentals for modern communication applications.

Course Objectives:

1	Understand microwave wave propagation, waveguides, and transmission characteristics.
2	Analyze microwave components, devices, and measurement techniques.
3	Study the operation of microwave tubes and solid-state microwave devices.
4	Learn the fundamentals and applications of radar systems.

Course Outcomes (COs):

After successful completion of this course, the student will be able to:

1	Explain microwave wave propagation, waveguide modes, and transmission characteristics.
2	Analyze microwave components, scattering parameters, and measurement techniques.
3	Demonstrate the operation and characteristics of microwave tubes and solid-state microwave devices.
4	Apply microwave and radar principles to evaluate system performance through practical and MATLAB-based experiments.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	-
CO4	2	3	3	3	-	-	-	-	-	-	-	2	-	-

List of Experiments

Expt. No.	Title of Experiment
1	Study of rectangular waveguide modes (TE/TM) and cutoff frequency measurement
2	Measurement of VSWR and standing wave pattern using slotted line
3	S-parameter measurement of waveguide or microstrip components using VNA
4	Smith chart impedance matching and microstrip stub tuning
5	Characterization of directional coupler and hybrid tee (coupling, directivity, isolation)
6	Performance test of attenuator, isolator, and circulator
7	Klystron or Reflex Klystron oscillator: frequency and power measurement
8	Gunn diode or IMPATT diode oscillator characterization
9	MATLAB Simulation of Radar Range Equation
10	MATLAB Simulation of Doppler Shift in CW/Doppler Radar

Text Books:

1	Samul Lion - Microwave Devices and Circuit, Prentice hall of India, 3rd edt. 2003
2	Annapurna das - Microwave Engineering, TMH Publication, 3rd edition, 2017.
3	J. D. Krause - Antenna Theory, SIE publication, 4th edition, 2017

Reference Books:

1	R.E. Collin, Foundation for Microwave Engg., Wiley Pub, 2nd edition, 2007.

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Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee103/preview
2	David M. Pozar, Microwave Engineering, Wiley Pub, 4th edition, 2013.
3	M.L. Sisodia, Microwave Active Devices, New agepublisher, 1st edition, 2003.

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Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**24ETCU6N16, Data Structures & Algorithms using C++**
Prerequisite/s			Basic programming knowledge and an understanding of fundamental data types
Teaching Scheme: Lecture/Tutorial/Practical			**01/00/02**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**25/00/00**
	P	**INT / OE/POE**	**00/00/25**
		Total	**50**

Course Description: This course introduces fundamental data structures like arrays, linked lists, stacks, queues, trees, and graphs, along with essential algorithms for searching and sorting. Students will learn to implement these structures and analyse the efficiency of these algorithms.

Course Objectives:

1	Inculcate basic principles and concepts of data structures in student.
2	Familiarize students with commonly used data structures and their associated algorithms used in industry.
3	Apply data structures and algorithms to solve programming problems efficiently.
4	Enhance problem-solving skills through practical implementation and programming assignments.

Course Outcomes (COs):

At the end of the course the student will be able to:

1	Analyze the time and space complexity of fundamental sorting and searching algorithms.
2	Comprehend the fundamental concepts of linked lists and implement basic operations on them.
3	Apply linear data structures such as stacks and queues to solve various computational problems.
4	Utilize tree and graph data structures and their traversal techniques for efficient problem-solving.

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CO1	3	3	1	2	1	-	-	-	1	-	-	1	1	1
CO2	3	2	2	1	1	-	-	-	1	-	1	2	-	1
CO3	3	3	2	1	2	-	-	-	1	-	1	2	1	1
CO4	3	3	3	2	2	-	-	-	1	-	1	2	-	1

Content	Hrs.
UNIT I: INTRODUCTION TO DATA STRUCTURES Data Structures, Types of data structure, Matrix representation using arrays: Row and column major, operations on matrices, Sparse Matrix, Sorting techniques with time complexity: Bubble sort, Insertion sort, Merge sort, Quick sort Searching techniques with time Complexity: Linear search, Binary search	4
UNIT II: LINKED LIST Introduction to linked list, Representation of Linked Lists in Memory, Singly Linked List, Doubly Linked List, Circular Linked List, Circular, Operations on linked list.	4
UNIT III: STACK AND QUEUE Stack: Introduction, Array Representation of Stack, Linked Representation of Stack, Applications of stack. Queue: Introduction, Array Representation of Queue, Linked list representation of Queue, Types of Queues: Circular Queue, Priority Queue, Applications of Queue.	4
UNIT IV: TREES AND GRAPHS Basic trees concept, Binary tree representation, Binary tree operation, Binary tree traversal, Binary search tree implementation, Threaded Binary tree. Basic concepts, Graph Representation, Graph traversal. Applications of trees & graphs.	4

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List of Experiments	
Expt . No.	**Name of Experiment**
1	Write a C++ program to perform insertion, deletion, traversal operations on an array.
2	Write a C++ program to implement Linear and Binary Search algorithms.
3	Implement the Bubble Sort algorithm in C++ to sort an array of integers.
4	Write a C++ program to implement the Insertion Sort algorithm for sorting an array of integers.
5	Implement the Merge Sort algorithm in C++ to sort an array of integers.
6	Write a C++ program to perform insertion, deletion and traversal operations on singly linked list.
7	Write a C++ program to perform insertion, deletion and traversal operations on doubly linked list.
8	Implement a stack data structure in C++ using an array. Include the push, pop, peek, and isEmpty operations.
9	Implement a queue data structure in C++ using a linked list. Include the enqueue, dequeue, peek, and isEmpty operations.
10	Write a C++ program for Binary tree traversal (Pre-order, Post-order, In-order traversal)
11	Write a C++ program to perform Insertion, traversal, search operations on Binary Search tree.

Text Books:

1	S. Lipschutz , 'Data Structures with C', Tata McGraw-Hill
2	Horowitz Ellis, Sahani –'Fundamentals of Data Structures in C++' -, Universities Press Publication
3	Richard F. Gilberg and Behrouz A. Forouzon, 'Data Structures- A Pseudocode Approach with C', Cengage Learning 2rd 2004 2 Data

Reference Books:

1	Michael T Goodrich –'Data Structures and Algorithms in C++' – 2nd Edition –Wiley Publication
2	Mark Allen Weiss -' Data Structures and Algorithm Analysis in C++ '-3rd Edition - Pearson Publication
3	R. Hubbard – 'SCHAUM'S OUTLINE OF DATA STRUCTURES WITH C++ '–. 1st Edition – McGraw Hill Education

Useful Links	
1	https://www.youtube.com/results?search_query=data+structure+nptel+course

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