

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
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**D.Y. Patil Education Society, Kolhapur
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School of Engineering & Management

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CO1	2	2	1	1	-	-	-	-	-	-	-	-	1	2	
CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	
CO3	1	1	1	1	-	-	-	-	-	-	-	-	1	1	
CO4	1	1	1	1											
CO5	2	2	2	1	-	-	-	-	-	-	-	-	1	2	
CO6	1	1	2	2	-	-	-	-	-	-	-	-	-	-	

Content	Hrs.
Unit I: Binary Codes and Boolean algebra Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non-weighted codes, self-complementary codes, BCD, Gray codes, Alphanumeric codes, ASCII Codes. Boolean algebra: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, De-Morgan's Theorem, Duality Theorems.	7
Unit II: Boolean Function Minimization Techniques Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. Karnaugh map: K-map, mapping and minimization of SOP and POS expression, Don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits	7
Unit III: Combinational Logic Design: Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder	7
Unit IV: Sequential Logic Design: Latches, flip-flops: S-R, D, JK and Master-Slave JK FF, Edge triggered FF, Flip Flop conversion, Use of preset and clear, Excitation Table and characteristic equations for flip flops, and Conversion of flip flops, Timing parameters of FF, Shift registers (SISO, SIPO, PIPO, and PISO).	7
Unit V: Counters and Finite State Machines: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter. FSM, Moore/Mealy machines, state diagram, state table, state assignment and state reduction, Sequence detector.	7
Unit VI: Memory and Programmable Logic Devices: Introduction, Memory Hierarchy, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory. read only memory, Overview of PLDs: PROM, PLA, PAL, GAL, CPLD, FPGA.	7

Text Books:

1	A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
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2	Anil K. Maini, "Digital Electronics: Principles and Integrated Circuits" 2nd Edition, Wiley India, 2017
3	R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication

Reference Books:

1	Zvi. Kohavi (2004), Switching and Finite Automata Theory, Tata McGraw Hill, India.
2	Donald D. Givone (2002), Digital Principles and Design, Tata McGraw Hill, India
3	Rajkamal 'Digital Systems Principals and Design' Pearson Education

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_ee39/preview
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**T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V**

Class		T.Y. B. Tech, Semester- V	
Course Code and Course Title		23ETCU5P02, 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	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.
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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

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	PS O1	PS O2	BTL
CO1	3	2	1	2	3			1	1	1	1	2	1		II
CO2	3	3	3	2	3		1			1	2	2	1	1	III
CO3	3	3	1	2	2		1			1		2	2	2	II
CO4	3	3	3	3	3		1			1	2	2	1		III
CO5	3	3	2	2	2		2			1	1	3			II
CO6	3	2	2	2	2		1			1	1	2			II

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: Actuators and mechanisms 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.	6
Unit IV: Microprocessors and microcontrollers 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



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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..	6
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	6

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.e.f.A.Y.2024-2025

(As Per National Education Policy 2020)

Semester-V

Class		T.Y. B. Tech, Semester- V	
Course Code and Course Title		23ETCU5P03, 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 magnetostatic 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.

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	13	14	15	16
CO1	3	2	1	1	2	-	-	-						2	1	III



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CO2	3	3	2	2	1	1	1	-					2	1	IV
CO3	3	3	2	2	2	1	1	-					2	1	IV
CO4	3	2	3	1	3	1	1	-					2	1	V

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	6
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.	6
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.	5
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 patch, circular patch, quality factor, bandwidth efficiency, input impedance, circular polarization, arrays and feed networks.	8

Text Books:

1	William Hayt, "Engineering Electromagnetics", Mc Graw Hill.
2	John. D. Kraus, "Antennas & Wave Propagation", Fifth Edition, Tata McGraw Hill.



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

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025

(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5P04 , Digital System Design Lab.
Prerequisite/s			Basics of digital electronics
Teaching Scheme: Lecture/Tutorial/Practical			00/00/02
Credits			01
Evaluation Scheme	T	ISE / MSE / ESE	00/00/00
	P	INT / OE/POE	25/00/25
		Total	50

Course Description: This laboratory course focuses on the practical design and implementation of fundamental digital logic circuits. Students will gain hands-on experience with combinational and sequential logic, including gates, adders, subtractors, multiplexers, decoders, flip-flops, and various counter types.

Course Objectives:

1	Introduce fundamental concept of digital techniques.
2	Enhance basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
3	Conduct the analysis and design of various digital electronic circuits
4	Develop a skill to build and troubleshoot digital circuits.

Course Outcomes (COs):

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

1	Understand number systems and its arithmetic operations and Illustrate use of Boolean algebra.
2	Formulate and apply Karnaugh Map to reduce Boolean expressions and logic circuits to their simplest forms
3	Design of combinational circuits like comparators multiplexers, de-multiplexers, encoder, decoder and different code converters.
4	Understand working of flip-flops, shift registers.
5	Design of sequential circuits like counters and FSM.
6	Understand Memory and Programmable Logic Devices (PLDs).

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

[illegible]



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CO2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	III
CO3	1	1	1	1	-	-	-	-	-	-	-	-	1	1	III
CO4	1	1	1	1											II
CO5	2	2	2	1	-	-	-	-	-	-	-	-	1	2	III
CO6	1	1	2	2	-	-	-	-	-	-	-	-	-	-	II

List of Experiments

Exp. No.	Name of Experiment
1	Design and implementation of basic logic gates
2	Design and implementation of basic Universal Logic Gates (NOR, NAND)
3	Design and implementation of K map based combinational logic.
4	Design and implementation of half adders, full adders
5	Design and implementation of half subtractor, full subtractor
6	Design and implementation of Study of 7 segment decoder
7	Design and implementation Multiplexers
8	Design and implementation De-multiplexer
9	Design and implementation of D, T, SR, JK Flip-flops
10	Design and implementation of SISO, SIPO, PIPO, and PISO Shift Registers
11	Design and implementation of MOD N counter
12	Design and implementation of Johnson Counter

Text Books:

1	A. Anand Kumar 'Fundamentals of Digital Circuits'. PHI Publications
2	Anil K. Maini , "Digital Electronics: Principles and Integrated Circuits" 2nd Edition, Wiley India, 2017
3	R.P. Jain-'Modern Digital Electronics' IIIrd Edition- Tata Mc Graw Hill, Publication

Reference Books:

1	Zvi. Kohavi (2004), Switching and Finite Automata Theory, Tata McGraw Hill, India.
2	Donald D. Givone (2002), Digital Principles and Design, Tata McGraw Hill, India
3	Rajkamal 'Digital Systems Principals and Design' Pearson Education

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_ee39/preview
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T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025

(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5P05, 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

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	BTL
CO1	3	2	1	2	3			1	1	1	1	2	1		II
CO2	3	3	3	2	3		1			1	2	2	1	1	III
CO3	3	3	1	2	2		1			1		2	2	2	II
CO4	3	3	3	3	3		1			1	2	2	1		III
CO5	3	3	2	2	2		2			1	1	3			II
CO6	3	2	2	2	2		1			1	1	2			II

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

Reference Books:

1	Robert Coughlin, Fredric Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth edition, PE, 2006. (Ch-6)
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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.e.f.A.Y.2024-2025

(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5P06 , 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.

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	1	1	2	-	-	-					2	1	III
CO2	3	3	2	2	1	1	1	-					2	1	IV
CO3	3	3	2	2	2	1	1	-					2	1	IV



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CO4	3	2	3	1	3	1	1	-					2	1	V
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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.

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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(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5M07, 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

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	1	-	-	-	-	-	-	-	-	-	1			II



**D.Y. Patil Education Society, Kolhapur
(Deemed to be University)**

School of Engineering & Management

Kasaba Bawada, Kolhapur

Department of Electronics and Telecommunication Engineering

CO2	3	2	2	-	3	-	-	-	-	1	-	2			III
CO3	3	1	-	-	-	-	-	-	-	-	-	1			II
CO4	3	3	3	2	3	1	-	-	1	1	1	2			III

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



**D.Y. Patil Education Society, Kolhapur
(Deemed to be University)**

School of Engineering & Management

Kasaba Bawada, Kolhapur

Department of Electronics and Telecommunication Engineering

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025

(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5M08, 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	PSO1	PSO2	BTL
CO1	3	1	-	-	-	-	-	-	-	-	-	1			II



**D.Y. Patil Education Society, Kolhapur
(Deemed to be University)**

School of Engineering & Management

Kasaba Bawada, Kolhapur

Department of Electronics and Telecommunication Engineering

CO2	3	2	2	-	3	-	-	-	-	1	-	2			IV
CO3	3	1	-	-	-	-	-	-	-	-	-	1			II
CO4	3	3	3	2	3	1	-	-	1	1	1	2			II

List of Experiments

Expt. No.	Name of Experiment
1	Overview of popular microcontroller simulators (MPLAB X Simulator, Proteus, Keil μ Vision 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

1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview
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**D.Y. Patil Education Society, Kolhapur
(Deemed to be University)**

School of Engineering & Management

Kasaba Bawada, Kolhapur

Department of Electronics and Telecommunication Engineering

**T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V**

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5O09, 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

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	1	2	2	1	-	-	-	1	-	2		3	IV
CO2	3	2	2	1	2	2	-	-	-	-	-	1		3	II
CO3	3	2	2	1	2	1	1	-	-	-	-	1		3	II
CO4	3	2	2	2	3	-	-	-	-	1	-	2		3	IV

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.	6
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.	6
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.
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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

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5010, Industrial Automation-II
Prerequisite/s			Basics of Electronics
Teaching Scheme: Lecture/Tutorial/Practical			02/00/00
Credits			02
Evaluation Scheme	T	ISE / MSE / ESE	00/00/50
	P	INT / OE/POE	00/00/00
		Total	50

Course Description:

This course introduces students to the fundamentals of industrial automation, focusing on the application of PLCs, SCADA, and DCS in automated control systems. It emphasizes system architecture, programming, and integration of industrial communication protocols in process industries.

Course Objectives:

1	To provide knowledge of basic concepts and principles of industrial automation systems.
2	To familiarize students with the fundamentals of logic development for automation processes.
3	To develop the ability to design and simulate ladder logic programs for real-time industrial applications using PLCs.
4	To impart hands-on skills in testing, debugging, and troubleshooting of digital and analog automation programs.
5	To explore SCADA and DCS architecture and their applications in monitoring and controlling large-scale industrial operations.

Course Outcomes (COs):

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

1	Summarize the fundamental principles of industrial automation
2	Apply the concepts of fundamentals of logic for various processes of automation.
3	Analyze and formulate the requirements of appropriate ladder programs to provide solutions using PLCs.
4	Construct, debug and test the programs developed for digital and analog operations.
5	Build architecture of SCADA and explain the importance of SCADA in critical infrastructure
6	Identify the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

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	PSO 1	PSO 2	BTL
CO1	3														II
CO2	3	2													III
CO3	3	3	3												III
CO4	3	3	3	2											III
CO5	3	2													II
CO6	3	2	2		2										II

Unit	Course Contents	Hours
1	Programmable logic Controller: Fundamentals of industrial automation, Definition and Goals of Automation, need and role of automation, evolution of automation. Types of processes, comparison, evolution of PLC, Types of Automation Hardware Components, Basic PLC structure, Types of PLC, Inputs and Outputs, Factors to consider in selecting PLC, General PLC Programming Procedure, PLC Programming Languages, Processor Memory Organization, Creating ladder diagram for real time task, Mnemonic Programming Code	6
2	PLC Functions: Programming Timers, Programming Counters, Program control instructions, Data Manipulation Instructions, Math Instructions, Sequence and Shift Register Instructions, Creating ladder diagram from process control descriptions, program editing, commissioning and monitoring, preventive maintenance and troubleshooting	6
3	Introduction to SCADA systems: Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture),	6
4	SCADA Protocols and SCADA systems in industries: Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Implementation of SCADA Systems and related various applications.	6

Text Books:

Sr. No	Title
1	Webb, J., & Ronald, R. (2007). Programmable Logic Controllers: Principles and Application (5th ed.). Prentice Hall of India.
2	Hackworth. (2008). Programmable Logic Controllers: Programming Methods and Applications (1st ed.). Pearson India.
3	Petruszella, F. (2007). Programmable Logic Controllers (3rd ed.). Elsevier India.
4	Thomas, M. S., & McDonald, J. D. (2015). Concept of SCADA System and its Evolution (1st ed.). CRC Press.
5	Radvonovsky, R., & Brodsky, J. (2013). Handbook of SCADA Control-System Security (1st ed.). CRC Press.

Reference Books:

Sr. No	Title
1	Batten, G. L. (2005). Programmable Controllers (2nd ed.). McGraw Hill Inc.
2	Bennett, S. (1988). Real Time Computer Control (1st ed.). Prentice Hall.
3	Doebelin, E. O. (1990). Measurement Systems (4th ed.). McGraw-Hill International Editions.
4	Clark, G., & Reynders, D. (2004). Practical Modern SCADA Protocols (1st ed.). ELSEVIER.
5	Srivastava, P. K. (2004). Programmable Logic Controllers with Applications (1st ed.). BPB Publications.

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU6E11, 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

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	PS O1	PS O2	BTL
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

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

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5E13, 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 students with a sound understanding of existing semiconductor devices to give meaning to their studies of electronic circuits and systems.
2	To explain carrier transport phenomena in solids on the basis of energy band theory and Boltzmann transport equation which forms the basis of electrical characteristics of semiconductor devices
3	To develop capability in students to learn on their own about the new researched devices as they keep emerging in the market in future and lay the foundation for of a constant career updating and self-education
4	To prepare the students for GATE in order to motivate them for higher studies.

Course Outcomes (COs):

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

1	Explain the formation of bandgaps in solids, formation of depletion-diffusion layer capacitance in p-n junction diodes and characteristics of illuminated p-n junction, incoherent (LEDs) and coherent light sources (Lasers)
2	Apply continuity equation and Poisson's equation to derive time dependence of carrier concentration on electric fields and potentials by considering band diagram of p-n junction in equilibrium.
3	Model the operation of bipolar junction transistor in three regions (cut-off, linear and saturation) using Ebers Moll coupled diode model.
4	Analyze BJT band diagram and explain current gain, base transport factor, and emitter injection efficiency.
5	Interpret C-V characteristics of MOS capacitor and I-V characteristics of JFET, MOSFET with relevance to their ethical parameters like pinch off voltage, threshold voltage etc

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	PSO 1	PSO 2	BTL
CO1	2													1	II
CO2	3													1	III
CO3	3	2													III
CO4	3	2													IV
CO5	2	2												1	IV

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

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.
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2	Donald. A. Neamen, “Semiconductor Physics and Devices: Basic Principles”, 3rd Edition, McGraw Hill Higher Education, 2003
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Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee86/preview

T.Y. B. Tech. Curriculum.e.f.A.Y.2024-2025
(As Per National Education Policy 2020)
Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			23ETCU5E13, 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.

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	12	PSO 1	PSO 2	BTL
CO1	3	2	2	1	1						1	2	1	III
CO2	3	2	2	1	1						1	2	1	IV
CO3	3	2	2	1	1						1	2	1	IV
CO4	2	2	1	1	1						1	2	1	II
CO5	3	2	2	1	1						1	2	1	III
CO6	3	2	3	1	2				1	1	2	3	3	III

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 fundamentals: 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

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