



SHRI MADHWA VADIRAJA INSTITUTE OF TECHNOLOGY AND MANAGEMENT

An Autonomous Institute Affiliated to VTU, Belagavi

A Unit of Shri Sode Vadiraja Mutt Education Trust®, Udupi
Approved by AICTE, New Delhi | Accredited by NAAC with 'A' Grade
Vishwothama Nagar, Bantakal – 574115, Udupi District, Karnataka



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROPOSED SCHEME & SYLLABUS

III SEMESTER

2025 SCHEME

AUTONOMOUS BATCH



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. in Electronics and Communication Engineering Scheme of Teaching and Examinations 2025														
Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)														
III SEMESTER														
Sl. No	Type of the course	Course code	Course title	TD	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW & SL	# TH/S	Duration in hours	CIE marks	SEE marks	Total marks	
				PSB	L	T	P	SL						
1	ASC	25MACC312	Transform Techniques and Optimization Theory	TD- Maths PSB - Maths	42	28	0	50	120	3	50	50	100	4
2	IPCC	25ECIP320	Digital System Design Using Verilog	TD: ECE PSB: ECE	42	0	28	50	120	3	50	50	100	4
3	PCC	25ECCC330	Network Analysis	TD: ECE PSB: ECE	42	0	0	48	90	3	50	50	100	3
4	PCC	25ECCC340	Analog Electronics and Linear Integrated Circuits	TD: ECE PSB: ECE	42	0	0	48	90	2	50	50	100	3
5	IPCC	25ECIP350	Python Programming	TD: ECE PSB: ECE	42	0	28	50	120	3	50	50	100	4
6	PCCL	25ECCL360	Analog Electronics and Linear Integrated Circuits Lab	TD: ECE PSB: ECE	0	0	28	2	30	2	50	50	100	1
7	AEC	25ECAE37X	Ability Enhancement Course Laboratory**	Respective Dept.	0	0	28	2	30	2	50	50	100	1
8	SDC	25HUSE380	Community Project (Project-Based Learning) / Societal Project	Respective Engineering Dept.	0	0	0	30	30	2	50	50	100	1
9	NCMC	25HUNC391	National Service Scheme (NSS)	NSS Coordinator	0	0	0	28	28	---	100	---	100	PP



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		25HUNC392	Sports and Athletics	Physical Education Director										
		25HUNC393	Yoga	Yoga Trainer										
		25HUNC394	Music	Music Teacher										
Total									658		500	400	900	21
10	NCMC	25MANC300	Mathematics course for Lateral Entry Students	TD/PSB –Maths Dept	14	0	0	14	28	3	100	---	100	PP
Total									686		600	400	1000	21
Type of course: CC – Core Course, CL – Core Lab, OE – Open Elective, PE – Professional Elective, IP – Integrated Professional core course, AE – Ability Enhancement Course, ET – Emerging Trend Course, PC – Programming Course, SE – Skill Enhancement course, PW – Project work (both mini and major project, MP - Mini Project, TS – Technical Seminar, IN – Internship, NCMC – Non Credit mandatory Course, TW & SL – Team Work & Self Learning, TH/S - Total Hours per Semester														

Ability Enhancement Course – III			
25ECAE371	Analog Electronic Circuit Simulations Lab	25ECAE373	Introduction to Data Structures and OOPs using Python Lab
25ECAE372	Digital Application Lab	25ECAE374	Programming Using JAVA Lab
National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.			

Digital System Design Using Verilog			Credits	4
Course Code	25ECIP320	Course type	IPCC	
Teaching Hours/Week (L:T:P:S)	3:0:2:4	Total Hours of Pedagogy in a semester	120 (42:0:28:50)	
CIE type	IA tests + CCA + Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: At the end of the course the student will be able to: 1. Apply Boolean algebra principles to simplify logic functions using Karnaugh Maps (K-Maps) and the Quine–McCluskey minimization technique. 2. Analyze the operation and behavior of combinational logic circuits and standard logic building blocks. 3. Design combinational digital systems using logic gates, multiplexers, decoders, and arithmetic circuits. 4. Analyze and design synchronous and asynchronous sequential circuits using SR, JK, D, and T flip-flops. 5. Model, simulate, and verify combinational and sequential digital circuits using the Verilog Hardware Description Language (HDL).				
Module-1			Number of hours: 8:0:0:10	
Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-up to 4 variables, Quine Mc Cluskey Minimization Technique. Quine-McCluskey using Don't Care Terms (Section 3.1 to 3.5 of Text1).				
Module-2			Number of hours: 8:0:0:10	
Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs) (Section 5.1 to 5.7 of Text2)				
Module-3			Number of hours: 8:0:0:10	
Introduction to Verilog: Structure of Verilog module, Styles of Description, Ports, Operators, Data Types (Section 1.1 to 1.6.2, 1.6.4 (only Verilog), of Text 3) Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description. (Section 2.1 to 2.2 (only Verilog) of Text3)				
Module-4			Number of hours: 10:0:0:10	
Flip-Flops and its Applications: The Master-Slave Flip-flops(Pulse-Triggered flip-flops): The basic bistable element, Latches, Timing Considerations, SR flip flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, J K, D and SR flip-flops, Finite State Machine Basics, Moore and Mealy Models (Section 6.1 to 6.4, 6.6 to 6.9 (Excluding 6.9.3) of Text2 & Section 6.1, 6.2 of Text1)				
Module-5			Number of hours: 8:0:0:10	
Verilog Behavioral Description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (Section 3.1 to 3.4 (only Verilog) of Text 3) Verilog Structural Description: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder (Section 4.1 to 4.2 of Text 3)				

Practical Component	Number of hours: 0:0:28:0
PART – A: FIXED SET OF EXPERIMENTS 1. To simplify the given Boolean expressions, implement it using Verilog, simulate the output, and verify the logic using the Digital Trainer Kit. 2. To design and simulate an Adder/Subtractor (Full/Half) using Verilog and verify the output of Full Adder/Subtractor (only) using LEDs on the Digital Trainer Kit. 3. To realize 4-bit ALU using Verilog program. 4. To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa and verify the output of any one of the code converters using the Digital Trainer Kit. 5. To realize using Verilog Behavioral description: 8:1mux, 8:3 encoder, Priority encoder and verify the output of priority encoder using Digital Trainer Kit. 6. To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2 -bit Comparator and verify the output of 1:8 Demux using Digital Trainer Kit. 7. To realize using Verilog Behavioral description: Flip-flops: a)JK type b)SR type c)T type and d) D type. 8. To realize Counters-up/down (BCD and binary) using Verilog Behavioral description. 9. Write Verilog Program to interface a Stepper motor to the FPGA/CPLD and rotate the motor in the specified direction (by N steps). 10. Verilog program to interface Switches and LEDs to the FPGA/CPLD and demonstrate its working. PART – B: OPEN ENDED EXPERIMENTS 1. Design and Optimization of a Combinational Logic System (using Verilog and Digital Trainer Kit) 2. Configurable Arithmetic Logic Unit (ALU) Design 3. Design of a Finite State Machine (FSM) for a Real-Time Application 4. Sequential Circuit Design Using Flip-Flops 5. Memory-Based System Design Using Verilog Concept PART -C: CONTENT BEYOND SYLLABUS 1. Design and Implementation of a 4-Bit Up/Down Counter Using IC 74LS190/74LS192 2. Design and Verification of a Universal Shift Register using Verilog and FPGA	
Suggested Learning Resources: (Textbook/ Reference Book/ Manuals): Textbooks: 1. J. M. Yarbrough, Digital Logic Applications and Design. Clifton Park, NY, USA: Thomson Learning, 2006. 2. D. D. Givone, Digital Principles and Design. New York, NY, USA: McGraw-Hill, 2002. 3. N. Botros, HDL with Digital Design: VHDL and Verilog. Dulles, VA, USA: Mercury Learning and Information, 2015 . Reference Books: 1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning 2. Fundamentals of HDL,by Cyril PR, Pearson/Sanguine2010 3. Logic Design, by Sudhakar Samuel, Pearson/Sanguine, 2007 Web links and e-Resources: 1. www.chipverify.com 2. https://www.youtube.com/watch?v=vHLBO05TeyU&list=PLwdnzIV3ogoVIY7iVqr-	

[FhWUQEX7JDdiP](#)

3. <https://www.youtube.com/playlist?list=PLbRMhDVUMngePP5JcezxImF-FzOC9wstz>
4. <https://www.youtube.com/watch?v=df2Toz3VWwc&list=PLcwp2fRcIXJUfkiaPTmkkVirPfRzfF8Zy>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of course outcomes.

1. Interactive lectures using digital design visualization tools and multimedia presentations to explain logic design concepts.
2. Simulation-based learning using Verilog HDL simulators to model, simulate, and verify digital circuits.
3. Flipped classroom methodology, where students study digital design concepts before class and engage in design exercises during class.
4. Mini-projects and project-based learning involving the design and verification of digital systems such as counters, ALUs, finite state machines, and controllers.
5. Collaborative learning activities through group discussions, peer reviews, and team-based design projects.
6. Continuous assessment through quizzes, Verilog coding challenges, and design reviews to reinforce learning and provide timely feedback.

Term work (TW) and Self-learning (SL) components

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities)

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Boolean Algebra, Karnaugh Maps and Quine–McCluskey Minimization	Assignment on logic minimization, K-map problem solving, GATE-based practice questions	Textbook 1, NPTEL Digital Circuits	5	Quiz
2	MSI Components and Programmable Logic Devices	Design assignment on adders, subtractors, multiplexers, decoders and comparators; laboratory demonstration	ChipVerify (www.chipverify.com), Textbook 2	5	Assignment
3	Introduction to Verilog HDL	Verilog coding exercises, simulation of combinational circuits, coding challenge	www.chipverify.com , HDLBits	5	Simulation in open source tool and report submission
4	Sequential Circuits and FSM	Design of a synchronous	HDLBits, NPTEL Digital Electronics	5	Quiz

		counter/FSM with simulation and presentation			
5	Behavioral and Structural Modeling using Verilog	Mini-project involving complete digital system implementation (e.g., traffic controller, electronic lock, ALU)	IIT Virtual Labs	5	Simulation/Quiz

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Boolean Function Minimization Techniques	Self-study of K-map and Quine–McCluskey method, solve additional design problems and participate in group discussion	NPTEL Digital Electronics, Textbook 1	5	Quiz
2	Design using MSI Components	Virtual lab exercises and literature review on practical applications of adders, multiplexers, decoders and PLDs	IIT Virtual Labs, ChipVerify	5	Quiz
3	Verilog HDL Fundamentals	Complete HDLBits beginner exercises and explore Verilog syntax through self-study	https://hdlbits.01xz.net/wiki/Main_Page	5	Quiz
4	Sequential Logic and FSM Applications	Self-study on digital controllers (traffic signal, vending machine, elevator control) and group discussion	NPTEL, IEEE Xplore (selected papers), HDLBits	5	Quiz
5	Advanced Verilog Modeling and FPGA Applications	Self-study on parameterized modules, hierarchical design, FPGA implementation videos, and literature review	HDLBits, Xilinx/Intel FPGA tutorials, ChipVerify	5	Quiz

Network Analysis			Credits	3
Course Code	25ECCC330	Course type	PCC	
Teaching Hours/Week (L:T:P:S)	3: 0: 0: 4	Total Hours of Pedagogy in a semester	90 (42:0:0:48)	
CIE type	IA tests + CCA	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	

Course outcome:

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

1. Analyze electronic networks using mesh and nodal analysis techniques for DC and AC circuits with dependent and independent sources.
2. Evaluate electronic circuit responses (currents, voltages, and power) using network theorems.
3. Analyze RL, RC, and RLC circuits under transient conditions using initial and final condition concepts.
4. Analyze linear electronic circuits using Laplace transform techniques.
5. Evaluate the performance of two-port networks by determining parameters and impedance characteristics.

Module-1	Number of hours: 8:0:0:12
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Basic Concepts: Mesh and Node Analysis. Introduction, Source of Electrical Energy, Kirchoff's Laws, Source transformations, General Network Transformations, Mesh and Node analysis with linearly dependent and independent sources for DC and AC networks

Module-2	Number of hours: 9:0:0:12
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Network Theorems: Introduction, Superposition Theorem, Reciprocity Theorem, Conditions for Reciprocity, Examples of Reciprocal/Non-Reciprocal circuits, Thevenin's Theorem, Maximum Power transfer theorem.

Case Study-1: Maximum Power Transfer in Electronic Systems Design.

Module-3	Number of hours: 8:0:0:10
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Transient behavior and initial conditions: Behavior of circuit elements under switching condition and their Representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.

Case Study: RC Circuit based Power-ON Delay in Electronic Indicator Systems.

Module-4	Number of hours: 8:0:0:06
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Laplace Transformation & Applications: Solution of networks, step, ramp and impulse responses, Waveform Synthesis, Transfer function of elementary passive circuits, Network Synthesis
Case Study: Concept of poles for first order passive filters and their use in computing time response characteristics and bandwidth.

Module-5	Number of hours: 9:0:0:08
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Two -Port Network: Introduction, Characterization of Linear Time-invariant Two-port Networks, Open Circuit Impedance Parameters, Short- circuit Admittance Parameters, Transmission Parameters, Hybrid parameters, Two port symmetry, Input impedance in terms of two port parameters, Output parameters.

Resonance: Series and Parallel resonance. Derivation of resonant frequency for series and parallel resonant circuits.

Suggested Learning Resources:**Books:**

1. M. E. Van Valkenburg (2000), Network Analysis, Prentice Hall of India, 3rd edition, 2000, ISBN:9780136110958.
2. Roy Choudhury-Networks and Systems, 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677

Reference Books:

1. Hayt, Kemmerly and Durbin-Engineering Circuit Analysis, TMH 7th Edition, 2010.
2. J. David Irwin/ R. Mark Nelms- Basic Engineering Circuit Analysis JohnWiley, 8th ed, 2006.
3. Charles K Alexander and Mathew NO Sadiku-Fundamentals of Electric Circuits, Tata McGraw-Hill, 3rd Ed, 2009

Web links and e-Resources:

1. <https://nptel.ac.in/courses/108105159>
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ee58
3. <https://www.youtube.com/channel/UC7GzgN-6rltc08EDBFPzUWg>
4. https://www.tutorialspoint.com/network_theory/index.htm

Teaching-Learning Process (Innovative Delivery Methods):

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world-and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Term work (TW) and Self-learning (SL) components

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities)

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Verification of Ohms' Law, Kirchhoff's Laws, Source Transformation Techniques	Project based Learning	1. https://www.tutorialspoint.com/network_theory/network_theory_kirchhoffs_laws.htm	02	Report
			2. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic	02	
2	Verification of Superposition Thevenin's and Maximum Power Theorems	Project based Learning	1. https://www.tutorialspoint.com/network_theory/network_theory_superposition_theorem.htm	06	Report
3	Transfer function of electric networks, Switching characteristics of inductor and capacitors	Assignment	1. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source 2. https://learn.mit.edu/c/unit/ocw?resource=3168&utm_source	02	Assignment
4	Basics of Laplace transform and various properties Laplace Transform	Assignment	1. https://onlinecourses.nptel.ac.in/noc24_ee58/preview?utm_source	02	Assignment
5	Verification of Two port Networks	Project based Learning	1. https://onlinecourses.nptel.ac.in/noc24_ee58/preview?utm_source 2. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source	02	Report
Total				16 Hours	

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Electrical quantities and units, Ohm's Law, Kirchhoff's Laws	Self-Study Virtual Lab	1. https://www.tutorialspoint.com/network_theory/network_theory_kirchhoffs_laws.htm 2. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source	04	Quiz

			electronics-spring-2007/resources/lecture-videos/?utm_source=chatgpt.com 3. https://www.allaboutcircuits.com/textbook		
	Series and parallel circuit Voltage and current division rules	Self-Study Virtual Lab	1. https://www.tutorialspoint.com/network_theory/network_theory_electrical_quantity_division_principles.htm 2. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic 3. https://www.allaboutcircuits.com/textbook	04	Quiz
2	Theorems using AC Sources	Self-Study Virtual Lab	1. https://www.tutorialspoint.com/network_theory/network_theory_superposition_theorem.htm 2. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source	06	Quiz
3	Transfer function of electric networks	Self-Study Virtual Lab	1. https://learn.mit.edu/c/unit/ocw?resource=3168&utm_source	02	Quiz
	Switching characteristics of inductors and capacitors Charging and Discharging Capacitors	Self-Study Virtual Lab	1. https://learn.mit.edu/c/unit/ocw?resource=3168&utm_source	06	Quiz
4	Basics of Laplace transform and various properties Laplace Transform	Self-Study Virtual Lab	1. https://onlinecourses.nptel.ac.in/noc24_ee58/preview?utm_source https://www.geeksforgeeks.org/laplace-transform/	04	Quiz
5	Interconnection of two-port networks	Self-Study Virtual Lab	1. https://onlinecourses.nptel.ac.in/noc24_ee58/preview?utm_source	03	Quiz
	Reciprocity and symmetry conditions	Self-Study Virtual Lab	1. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/?utm_source	03	Quiz
Total				32 Hours	

ANALOG ELECTRONICS AND LINEAR INTEGRATED CIRCUITS			Credits	03
Course Code	25ECCC340	Course type	PCC	
Teaching Hours/Week (L:T:P:S)	3:0:0:3	Total Hours of Pedagogy in a semester	90 (42:0:0:48)	
CIE type	IA tests + CCA	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: At the end of the course, the student will be able to: 1. Describe the working principle, fundamental characteristics of various semiconductor devices such as transistors, MOSFETs, and operational amplifiers in basic electronic circuits. 2. Analyze basic amplifier circuits using the principles BJTs, MOSFETS, and operational amplifiers. 3. Illustrate the fundamental concepts of oscillators and timers. 4. Design basic filters and power amplifiers. 5. Analyze the fundamental concepts of linear Op-Amps, linear Op-Amps and their applications. 6. Analyze the electronic circuit schematic and its working.				
Module-1.			Number of hours: 9:0:0:9	
BJT AC Models: Base Biased Amplifier, Emitter Biased Amplifier, Small Signal Operation, AC Beta, AC Resistance of The Emitter Diode, Two Transistor Models, Analyzing Amplifier. Voltage Amplifiers: Voltage Gain, Multistage Amplifiers. CC And CB Amplifiers: CC Amplifier, Output Impedance, Cascading CE And CC, Darlington Connections, Voltage Regulation, The Common Base Amplifier. Text book 1: 8.1-8.7, 8.9, 9.1, 9.3-9.8				
Module-2			Number of hours: 9:0:0:9	
MOSFET Biasing in MOS Amplifier Circuits: Fixing VGS, Fixing VG, Drain to Gate Feedback Resistor. Small Signal Operation and Modelling: The DC Bias Point, Signal Current in Drain, Voltage Gain, Small Signal Equivalent Circuit Models, Transconductance, The T Equivalent Circuit Model. MOSFET Amplifier Configuration: Basic Configurations, Characterizing Amplifiers, CS Amplifier with And Without Source Resistance, The Common Gate Amplifier, Source Follower. Text book 2: 7.2, 7.2.1, 7.3, 7.3.1 - 7.3.6, 7.4, 7.4.1				
Module-3			Number of hours: 8:0:0:10	
Negative Feedback: Four Types of Negative Feedback, VCVS Voltage Gain, Other VCVS Equations, ICVS Amplifier, VCIS Amplifier, ICIS Amplifier (No Mathematical Derivation). Oscillator: Theory of Sinusoidal Oscillation, The Wein-Bridge Oscillator, RC Phase Shift Oscillator, The Colpitts Oscillator, Hartley Oscillator, Crystal Oscillator. The 555 Timer: Monostable Operation, Astable Operation. Text book 1: 17.1-17.6, 21.1-21.8				
Module-4			Number of hours: 8:0:0:10	
Power Amplifiers: Amplifier Terms, Two Load Lines, Class A Operation, Class B Operation, Class B Push Pull Emitter Follower, Class C Operation. Active Filters: Ideal Responses, First Order Stages, VCVS Unity Gain Second Order Low Pass				

Filters, VCVS Equal Component Low Pass Filters, VCVS High Pass Filters, MFB Bandpass Filters, Bandstop Filters.

Text book 1: 10.1-10.5, 10.8, 19.1, 19.4, 19.5, 19.7-19.10

Module-5

Number of hours: 8:0:0:10

Linear Op-amp Circuits: Digital to Analog Conversion: Weighted Resistor DAC, R-2R DAC, Analog to Digital Conversion: Digital RAMP ADC, Successive Approximation ADC. Signal Processing Circuits: Saturating and Non Saturating Precision HWR, Precision FWR Using HWR and Summing Circuit.

Nonlinear Op-Amp Circuits: Zero Crossing Detector, Inverting Schmitt Trigger Circuit, Non-Inverting Schmitt Trigger Circuit.

DC Voltage Regulators: Introduction, Voltage Regulator Basics.

Text book 3: 15.2, 15.4, 9.1, 9.2, 8.2-8.4, 13.1

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):

Textbooks:

1. Albert Malvino, David J Bates, Patrick E. Hoppe, Electronic Principles, 9th Edition, Mc Graw Hill Education, 2021.
2. Adel S Sedra, Kenneth C Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2015.
3. David A. Bell, Operational Amplifiers and Linear ICs, 3rd Edition, Oxford University Press, 2011.

Reference Books:

1. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
2. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

Web links and e-Resources:

- <https://nptel.ac.in/courses/108102112>
- https://onlinecourses.nptel.ac.in/noc25_ee157/preview
- <https://nptel.ac.in/courses/108106188>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various analog and digital circuits.
3. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
4. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
5. Arrange visits to nearby industries to give brief information about the electronics manufacturing industry.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Term work (TW) and Self-learning (SL) components

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities)

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Numerical problems from BJT biasing and amplifier	Assignment	Google class room	5	Assignment
2	Current sources and current mirrors, biasing with current sources, constant gm circuits	Assignment on CS amplifier and biasing , GATE-based practice questions	https://nptel.ac.in/courses/108102112	5	Quiz
3.	PCB design project oscillators /timer application)	Project-Based Learning	https://www.nptel.ac.in/courses/108102481?utm_source=chatgpt.com	5	Demo
4.	Design & analysis the working of various active filters / os	Mini-project	https://ae-iitr.vlabs.ac.in/	5	Simulation/Quiz
5.	Simulation projects on Operational amplifier application	Mini-project	https://ae-iitr.vlabs.ac.in/	5	Simulation/Quiz

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Frequency Response of CE Amplifiers Considering HF Models of BJT	MOOC	https://www.youtube.com/watch?v=Mkp4LpvQyow	4	VIVA/QUIZ
2	Frequency Response of CS	MOOC	https://www.youtube.com/watch?v=Mkp4LpvQyow	4	VIVA/QUIZ

	Amplifiers Considering HF Models of MOSFET				
3	Fixed Transcondu ctance Bias Circuits from First Principles	MOOC	https://www.youtube.com/watch?v=jnKL-o27HAW&t=1s	5	VIVA/QUIZ
4	Selection of ADC and DAC in Digitally Controlled SMPCs	MOOC	https://www.youtube.com/watch?v=-nYHOaQ0UNs	5	VIVA/QUIZ
5	Analog Filters for Realtime Audio - George Gkountoura s - ADC 2025	MOOC	https://www.youtube.com/watch?v=NLt0NqUtNLo	5	VIVA/QUIZ

PYTHON PROGRAMMING			Credits	4
Course Code	25ECIP350	Course type	IPCC	
Teaching Hours/Week (L:T:P:S)	3:0:2:4	Total Hours of Pedagogy in a semester	120(42:0:28:50)	
CIE type	IA tests + CCA + Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course outcome (Course Skill Set)				
At the end of the course, the student will be able to:				
1. Acquire programming skills in Python				
2. Demonstrate data structure representation using Python				
3. Develop the skill of pattern matching and files in Python				
4. Acquire Object Oriented Skills in Python				
5. Develop the ability to write database applications in Python				
Module-1			Number of hours: 9:0:0:15	
Python Basics, Python language features, History, Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number				
Text book 1: Chapters 1-3				
Module-2			Number of hours: 8:0:0:20	
Data Structures: Lists: The List Data Type, Working with Lists Strings: Manipulating Strings, Working with Strings, Useful String Methods Tuples and Dictionaries, basics Using Data Structures to Model Real World Things, Manipulating Strings.				
Text book 1: Chapters 4-6				
Module-3			Number of hours: 8:0:0:5	
Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions,, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols. Reading and Writing Files, Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint. pformat() Function				
Text book 1: Chapters 7, 8				
Module-4			Number of hours: 9:0:0:5	
Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism.				
Text book 2: Chapters 15- 18				

Module-5	Number of hours: 8:0:0:5
HTTP, The World's simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, XML, Parsing XML, Looping through nodes, JSON, What is database?, Database Concepts, Database Browser, Creating a database table, SQL, Spidering Twitter, Basic data modeling, Programming with multiple tables, Three kinds of Keys, JOIN Text book 3: Chapters12,13(Upto13.5),15	
Practical Component	Number of hours: 0:0:28:0
- Develop a python program to read 2 numbers from the keyboard and perform the basic arithmetic operations based on the choice. (1-Add, 2-Subtract, 3-Multiply, 4-Divide). - Develop a program to read the name and year of birth of a person. Display whether the person is a senior citizen or not. - Develop a program to generate Fibonacci sequence of length (N). Read N from the console. - Write a python program to create a list and perform the following operations - Inserting an element - Removing an element - Appending an element - Displaying the length of the list - Popping an element - Clearing the list - Read N numbers from the console and create a list. Develop a program to print mean, variance and standard deviation with suitable messages. - Read a multi-digit number (as chars) from the console. Develop a program to print the frequency of each digit with a suitable message. - Develop a program to print 10 most frequently appearing words in a text file. [Hint: Use a dictionary with distinct words and their frequency of occurrences. Sort the dictionary in the reverse order of frequency and display the dictionary slice of the first 10 items. - Develop a program to read 6 subject marks from the keyboard for a student. Generate a report that displays the marks from the highest to the lowest score attained by the student. [Read the marks into a 1-Dimesional array and sort using the Bubble Sort technique]. - Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. [Hint: Use string methods strip (), len(), list methods sort(), append(), and file methods open(), readlines(), and write ()]. - Develop a function named DivExp which takes TWO parameters a, b, and returns a value c ($c=a/b$). Write a suitable assertion for $a>0$ in the function DivExp and raise an exception for when $b=0$. Develop a suitable program that reads two console values and calls the function DivExp. - Define a function that takes TWO objects representing complex numbers and returns a new complex number with the sum of two complex numbers. Define a suitable class 'Complex' to represent the complex number. Develop a program to read N ($N \geq 2$) complex numbers	

and to compute the addition of N complex numbers.

9. Text Analysis Tool: Build a tool that analyses a paragraph: frequency of each word, longest word, number of sentences, etc.
10. Develop Data Summary Generator: Read a CSV file (like COVID data or weather stats), convert to dictionary form, and allow the user to run summary queries: max, min, average by column.
11. Develop Student Grade Tracker: Accept multiple students' names and marks. Store them in a list of tuples or dictionaries. Display summary reports (average, topper, etc.).
12. Develop a program to display contents of a folder recursively (Directory) having sub-folders and files (name and type).

Open-ended Experiment:

1. GUI Developer: Develop a simple calculator

Content Beyond Syllabus:

2. Develop a Python program to check whether a given number is a palindrome or not, and also count the number of occurrences of each digit in the input number.

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):

Textbooks:

1. Al Sweigart, "Automate the Boring Stuff with Python", 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>)
2. Allen B Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>) (Chapters 15 - 18) (Download pdf/html files from the above links)
3. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st, Create Space Independent Publishing Platform, 2016

Web links and e-Resources:

- <https://www.youtube.com/watch?v=xQNeOTRyig>
- <https://www.youtube.com/watch?v=kqtD5dpn9C8>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various programming concepts.
3. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
4. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
5. Discuss how every concept can be applied to the real world - and when that's possible,

it helps improve the students' understanding.

Term work (TW) and Self-learning (SL) components

Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities)

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Python Programming Basics and Debugging	Quiz	https://www.python.org/about/gettingstarted/	2	Quiz
2	Basics of Data Structures	Assignments	https://www.geeksforgeeks.org/python/python-functions/	10	Assignment

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Python Programming Basics and Debugging: Introduction to Python, concept of program, syntax errors, runtime errors, semantic errors, experimental debugging, variables, expressions, statements, operators, input, type conversion, string operations, modulus operator.	Self-Study	Python Tutorial: https://docs.python.org/3/tutorial/introduction.html	4	Quiz / Assignment
1	Iteration and Loop-Based Problem Solving: Assignment, updating variables, for loop, while loop, table generation, two-dimensional tables, break, continue, paired data, nested loops.	Self-Study	Python Control Flow: https://docs.python.org/3/tutorial/controlflow.html	4	Quiz / Assignment
1	Functions in Python: Functions with arguments and return values, function definition, function call, parameter passing, simple problem-solving using functions.	Self-Study	Python Functions: https://docs.python.org/3/tutorial/controlflow.html#defining-functions	5	Quiz / Assignment

2	String Processing and Manipulation: String length, traversal, slicing, comparison, immutability, in and not in, find function, looping and counting, optional parameters, built-in find(), split(), string cleaning, string formatting.	Self-Study	Python String Methods: https://docs.python.org/3/library/stdtypes.html#string-methods/	5	Quiz / Assignment
2	Tuples and Lists: Tuple grouping, tuple assignment, tuples as return values, list values, accessing elements, list length, membership, list operations, list slices, mutability.	Self-Study	Python Data Structures: https://docs.python.org/3/tutorial/datastructures.html	5	Quiz / Assignment
3	File Handling and Modules: Writing files, reading files line-by-line, reading whole files, converting files into list of lines, binary files, directories, fetching content from the web, random module, time module, math module, creating user-defined modules	Self-Study	Python File I/O: https://docs.python.org/3/tutorial/inputoutput.html#reading-and-writing-files Python Modules: https://docs.python.org/3/tutorial/modules.html	5	Quiz / Assignment
4	Classes and objects, Classes and functions: Attributes, Instances as return values, Object oriented features, Operator overloading, Polymorphism	Self-Study	OOPs with python https://www.classcentral.com/course/youtube-object-oriented-programming-oop-in-python-beginner-crash-course-117191	5	Quiz / Assignment
5	HTTP: Retrieving an image over HTTP, Parsing XML, looping through nodes, Database Concepts: Spidering Twitter, basic data modeling, types of Keys	Self-Study	HTTP: https://www.tutorialspoint.com/http/index.htm Database https://www.geeksforgeeks.org/dbms/dbms/	5	Quiz / Assignment

ANALOG ELECTRONICS AND LINEAR INTEGRATED CIRCUITS LAB			Credits	01
Course Code	25ECCL360	Course type	PCCL	
Teaching Hours/Week (L:T:P:S)	0:0:2:1	Total Hours of Pedagogy in a semester	30 (00:00:28:02)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: This laboratory course enables students to 1. Design and analyze the BJT/FET amplifier and oscillator circuits. 2. Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers. 3. Demonstrate the basic circuit experiments using 555 timer.				
Part A Conventional Experiments			Number of hours: 0:0:20:0	
1. Design and Set-up the BJT Common Emitter Voltage Amplifier with and Without Feedback and Determine the Gain, Bandwidth, Input and Output Impedance. 2. Design and Set-up BJT/ FET Based I) Colpitts Oscillator, II) Crystal Oscillator 3. Realize BJT Darlington Emitter Follower and Determine Gain, Input and Output Impedances. 4. Design 4-Bit R - 2R OP-Amp Digital to Analog Converter: I) For A 4-Bit Binary Input Using Toggle Switches, II) By Generating Digital Inputs Using Mod-16 5. Design and Test the Second Order Active Filters and Plot the Frequency Response: I) Low Pass Filter, II) High Pass Filter 6. Design and Testing of Precision Rectifiers: I) Half-Wave Precision Rectifier, II) Full-Wave Precision Rectifier 7. Design and Test Monostable and Astable Multivibrator Using 555 Timer. 8. Design and Test a Regulated Power Supply Using IC 7805 And IC 7905. <u>Content beyond experiment:</u> 1. Automatic Battery Charger with Overcharge Protection				
Part B Open ended experiments			Number of hours: 0:0:08:0	
1. Design a FET Voltage Series Feedback Amplifier and Determine the Gain, Input and Output Impedances. 2. Design and Experimental Study of a Class-C Tuned Amplifier 3. Design of a Schmitt Trigger for Given UTP And LTP. 4. Design and Testing of a Sample and Hold Circuit.				

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):**Textbooks:**

1. Electronic Devices and Circuits, David A Bell, 5th Edition, Oxford, 2018.
2. Op-amps and Linear Integrated Circuits, Ramakanth A Gayakwad, Pearson Education, 4th Edition.
3. Basic electronics, D.P Kothari and I J Nagrath, McGraw Hill Education Pvt Ltd, 2015. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, PHI, 2016.

Web links and Video Lectures (e-Resources):

1. <http://digimat.in/nptel/courses/video/108102112/L01.html>
2. <https://www.youtube.com/playlist?list=PLp6ek2hDcoNDAw1BehPFazZ5ogPV8UIQa>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of course outcomes.

1. While explaining each experiment, also focus on the application of that particular experiment in the electronics industry
2. In labs utilizing software programming, the emphasis must be on student understanding of the logic (e.g. pseudo-code) of the code, which libraries are required, which important functions calls need to be made and expected output. Faculty should not penalize students for making syntax errors in codes in the write up – however students must be able to debug the errors during program execution
3. Students should not memorize pin diagrams, these must be provided to the student during CIE and SEE
4. For record writing, faculty should ensure students write the main objective, design and procedure in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels.

Self-learning (SL) components

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Clipper and Clamper circuits using diode	Virtual lab	https://aec-iitkgp.vlabs.ac.in/exp/active-filter/	2	Viva

Analog Electronic Circuit Simulations Lab (NI Multisim)			Credits	1
Course Code	25ECAE371	Course type	AEC	
Teaching Hours/Week (L:T:P:S)	0:0:2:0	Total Hours of Pedagogy in a semester	30 (00:00:28:02)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: At the end of the course the student will be able to: 1. Apply analog circuit concepts to design and test amplifier, filter, and switching circuits. 2. Apply transistor concepts to realize oscillator and emitter follower circuits. 3. Apply operational amplifier concepts to implement analog signal processing and digital-to-analog conversion circuits. 4. Apply timer and power electronic device concepts to realize multivibrators and analyze SCR characteristics.				
Set of Experiments			Number of hours: 0:0:28:0	
1	Design and test of second order RC Low Pass and High Pass Filters and study the frequency response, cutoff frequency, and signal filtering behavior.			
2	Simulation of BJT as an Electronic Switch and study the cutoff and saturation operation and LED switching process.			
3	Design and set-up of BJT Common Emitter Amplifier with and without feedback and analyze the voltage gain, phase reversal, and signal amplification.			
4	Design and Set-up BJT/FET based I) Colpitts Oscillator and II) Crystal Oscillator.			
5	Realize BJT Darlington Emitter Follower and determine gain.			
6	Simulation of Inverting, Non-Inverting, Voltage Follower and Summing Amplifiers and understanding the concept of gain control, feedback, and phase relationship.			
7	Design 4-bit R-2R op-amp digital to analog converter: I) For a 4-bit binary input using toggle switches and II) By generating digital inputs using Mod-16.			
8	Design and test Monostable and Astable Multivibrator using 555 timers.			
9	Design and test precision rectifiers: I) Half-wave precision rectifier and II) Full-wave precision rectifier.			
10	Study the Characteristics of SCR.			
Content Beyond Syllabus				
1	Automatic Street Light Controller using LDR			
2	Electronic Doorbell using 555 Timer			
Suggested Learning Resources: (Textbook/ Reference Book/ Manuals): Textbooks: 1. Electronic Devices and Circuits, David A Bell, 5th Edition, Oxford, 2018. 2. Basic Electronics, D. P Kothari and I J Nagrath, McGraw Hill Education Pvt. Ltd., 2015. 3. Operational Amplifiers and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, PHI Learning Private Limited, 2015 4. M. H. Rashid, "Power Electronics, circuits, devices and applications", 4th Edition, Pearson Prentice Hall, Upper Saddle River, 2018.				

Reference Books:

1. Fundamentals of Microelectronics, Behzad Razavi, 3rd Edition, Wiley Publications, 2021.
2. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, 4th Edition, McGraw-Hill Education, 2014.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/108106188> – NPTEL Course on Analog Circuits by IIT Madras
- <https://www.analog.com/en/resources/design-tools-and-calculators/ltspice-simulator.html> - LTSpice Analog Devices

Teaching-Learning Process (Innovative Delivery Methods):

The following innovative delivery methods may be adopted to accelerate the attainment of course outcomes:

1. Simulation-based learning using NI Multisim for designing and analysing analog electronic circuits.
2. Waveform visualization to study transient response, frequency response, voltage/current variations, gain, ripple, and switching behaviour.
3. Predict-simulate-verify approach where students predict circuit output before simulation and compare it with simulated results.
4. Parameter variation studies by changing R, C, input voltage, feedback resistance, diode/transistor/MOSFET parameters, etc., to observe circuit behaviour.
5. Theory-simulation comparison to correlate calculated values with simulation results.
6. Circuit debugging activities to identify and correct simulation errors such as wrong connections, incorrect biasing, or missing ground.
7. Application-oriented learning by relating circuits to real-world applications such as rectifiers, filters, amplifiers, voltage regulators, switching circuits, and sensor interfacing.
8. Mini-project-based learning to encourage design thinking and practical implementation of analog electronic systems.
9. Self-learning activities using online simulators, virtual labs, and e-resources for additional practice beyond laboratory hours.
10. Viva and discussion-based assessment to improve conceptual clarity, interpretation of results, and attainment of course outcomes.

Self-learning (SL) components

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Automatic Fan Controller using Temperature Sensor	Mini-Project: Design and simulate a temperature-based automatic switching circuit.	NI MULTISIM LM35 DataSheet MULTISIM LIVE TUTORIAL	2	Circuit design, simulation output, threshold verification, brief report, and viva.
2	Audio Mixer using Summing Amplifier	Mini-Project: Design and simulate an op-amp based signal mixing circuit.	TI Op-Amp Guide		

Digital Application Lab			Credits	1
Course Code	25ECAE372	Course type	AEC	
Teaching Hours/Week (L:T:P:S)	0:0:2:0	Total Hours of Pedagogy in a semester	30 (00:00:28:02)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	

Course Outcomes:

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

1. Understand the basic concepts of digital electronics.
2. Develop an application for domestic appliances.
3. Develop an application for industry control.
4. Develop an application for automotive application.

Set of Experiments	Number of hours: 0:0:28:0
1. To construct logic circuit of washing machine control using a generalized simulator and verify its output. 2. Conduct an experiment to apply the basic OR gate logic in industrial control process. The user will be able to drag and drop the OR gate on the blank canvas and make input-output connections and verify the truth table. 3. Conduct an experiment to apply a basic NOT gate logic in an 8-bit one's complement circuit. The user will be able to build, simulate and verify the 8-bit one's complementing circuit using the generalized simulator (a blank canvas with click & place facility for selected gates). 4. To apply the NOT gate logic in an application to indicate that the fuel level in a tank has reached the minimum (reserve) level. The user can compute the output of a given circuit with the help of a generalized simulator. The user will be able to construct, simulate and verify the output of the fuel level application. 5. To study the application of a combination of AND and NOT gates in a seat belt warning indicator. The user will be able to construct, simulate and verify the seat belt warning application using the generalized simulator. Display the output on red LED. 6. Conduct an experiment to apply basic AND gate logic to control the on/off action of car wiper. The user will be able to drag and drop the two-input AND gate on the blank canvas and make input-output connections and verify the truth table. 7. To apply the combination of AND & NOT gates in water level controller application. The user will be able to find the output status of the electronic lock for given combination of inputs. The user will be able to analyze, construct and simulate to verify any combinational logic circuit for a given problem statement using the generalized simulator. 8. To study the application of a combinational electronic lock using basic logic gates. The user will be able to design a 4-digit electronic code lock using two-input basic logic gates. Using the generalized simulator, the user can implement his design and verify it's working. 9. To apply NAND gate logic in a level monitoring system in a chemical plant. Using generalized simulator framework, the user will be able to place a NAND gate, make input-output connections and verify its truth table. 10. To build automobile alarm application using basic logic gates on a generalized simulator canvas and verify its truth table. 11. To construct a cockpit warning light control system using the generalized simulator. The users will be able to state the output condition for given set of combinations of input. The users will be able to select the correct Boolean expression for given combinational circuit. 12. To construct a half adder circuit and verify its truth table using the generalized simulator	

framework.

13. Verify Binary to Gray and Gray to Binary conversion using NAND gates only.

Content Beyond Syllabus

1. Design and Simulation of a Smart Home Automation System.
2. Design and Simulation of a Digital Traffic Signal Controller.

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):

Textbooks:

1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 /Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
3. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011
4. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013

Web links and e-Resources: <https://da-iitb.vlabs.ac.in/>

Teaching-Learning Process (Innovative Delivery Methods):

1. These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.
2. While explaining each experiment, also focus on the application of that particular experiment in the electronics industry
3. In labs utilizing software programming, the emphasis must be on student understanding of the logic (e.g. pseudo-code) of the code, which libraries are required, which important functions calls need to be made and expected output. Faculty should not penalize students for making syntax errors in codes in the write up – however students must be able to debug the errors during program execution
4. Students should not memorize pin diagrams; these must be provided to the student during CIE and SEE
5. For record writing, faculty should ensure students write the main objective, design and procedure in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels.

Self-learning (SL) components

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Combinational Logic Circuit	Build your own combinational logic circuit using generalized simulator using Virtual Lab.	IIT Bombay Virtual Labs: https://da-iitb.vlabs.ac.in/	2	Quiz / Simulation

Introduction to Data Structures and OOPs using Python Lab			Credits	1
Course Code	25ECAE373	Course type	AEC	
Teaching Hours/Week (L:T:P:S)	0:0:2:0	Total Hours of Pedagogy in a semester	30 (00:00:28:02)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: At the end of the course the student will be able to: 1. Analyse various linear and non-linear data structures. 2. Demonstrate the working nature of different types of data structures and their applications. 3. Use appropriate searching and sorting algorithms for the give scenario. 4. Apply the appropriate data structure for solving real world problems.				

SET OF EXPERIMENTS	Number of hours: 0:0:28:0
1. Develop a program in Python for the following: a) Find factorial of a number. b) Generate Fibonacci series. c) Check prime number. 2. Develop a program in Python for the following: a) Recursive factorial. b) Recursive Fibonacci. c) Tower of Hanoi simulation (using recursion). 3. Develop a program in Python to perform operations on strings and files: a) Count vowels, words, and characters. b) Search and replace text in a file. c) Read sensor-like data from a text file. 4. Implement programs using Python built-in data structures: a) Student record management using dictionaries. b) Remove duplicates using sets. c) Matrix operations using nested lists. 5. Implement programs using Python for stack operations using lists: a) Push, pop, display. b) Infix to postfix conversion. c) Parenthesis balancing. 6. Develop programs using Python to implement queue data structures: a) Linear queue	

b) Circular queue c) Simple task scheduling simulation 7. Develop programs using Python to implement basic searching and sorting algorithms: a) Linear search. b) Binary search. c) Bubble sort. 8. Develop programs using Python to implement singly linked list operations: a) Insert at beginning/end. b) Delete a node. c) Traverse linked list. 9. Develop Python programs using OOP concepts: a) Create a class named circuit_measurement with class data variables Voltage and Current, and methods power_estimation () and resistance_estimation (). Implement the above class in a user program b) Create a class named rectangle to polar with data variables real and imag, and methods radius () and angle () (in radians). Use this class to perform rectangular-to-polar coordinate conversion 10. Develop programs using Python to implement inheritance-based applications: a) Shape hierarchy (Circle, Rectangle, Triangle) b) Employee payroll system. 11. Develop a small real-world application: Digital calculator using tkinter module	Content Beyond Experiment 1. Develop a Python program to read data from a CSV file, perform basic operations such as searching, filtering, and calculating summary statistics, and display the results. 2. Develop a Python program to visualize a dataset using line, bar, pie, histogram, and scatter plots with the Matplotlib library. Suggested Learning Resources: (Text Book/ Reference Book/ Manuals): Text books: 1. Data Structures and Algorithms with Python by Kent D. Lee and Steve Hubbard. 2. Data structures and algorithms in python by Michael T. Goodrich 3. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum. Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/106106145 • https://onlinecourses.nptel.ac.in/noc20_cs26/announcements?force=true
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3. Students should not memorize pin diagrams, these must be provided to the student during CIE and SEE
4. For record writing, faculty should ensure students write the main objective, design and procedure in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels. in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels.

Self-learning (SL) components

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Data Visualization Using Python	Mini-Project	https://www.py4e.com?utm_source=chatgpt.com	2	VIVA

Programming Using JAVA Lab			Credits	1
Course Code	25ECAE374	Course type	AEC	
Teaching Hours/Week (L:T:P:S)	0:0:2:0	Total Hours of Pedagogy in a semester	30 (00:00:28:02)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	
Course Outcomes: At the end of the course the student will be able to: 1. To learn primitive constructs JAVA programming language. 2. Ability to learn and apply concepts of Java programming, exceptional handling and inheritance. 3. To understand object-oriented programming features of JAVA. 4. To gain knowledge on: packages, multithreaded programming and exceptions.				

SET OF EXPERIMENTS
1. Write a JAVA program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$. Read in a, b, c and use the quadratic formula. 2. Write a JAVA program to implement 555 Timer Frequency Calculator 3. Demonstrate the following operations and sign extension with Java programs (i) << (ii) >> (iii) >>> 4. Create a JAVA class called AC power with the following details as variables within it. Voltage, Current, Phase angle Write a JAVA program to create power objects and print the voltage, current, active power, apparent power, reactive power, instantaneous power, and power factor of these objects with suitable headings. 5. Write a JAVA program to implement ADC Bit-Resolution Quantizer 6. Design a super class called Staff with details as Staff Id, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a JAVA program to read and display at least 3 staff objects of all three categories. 7. Write a JAVA Program to Simulate a Multi-Waveform Function Generator using Runtime Polymorphism 8. Write a Java program that implements Quick sort algorithm for sorting a list of names in ascending order.

9. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -, *, % operations. Add a text field to display the result. Handle any possible exceptions like divided by zero.
10. Write a Java Program that simulates a Traffic Light. The program lets the user select one of three lights: red, yellow, Green with radio buttons. On selecting radio button, an appropriate message with "stop" or "Ready" or "GO" should appear above the button in selected color. Initially, there is no message shown
11. Write a JAVA program to demonstrate Hardware Isolation and Signal Access Control using Java Packages
12. Write a Java program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.

Content Beyond Syllabus

1. Develop a Java program to create, read, write, and append data to a text file using the java.io or java.nio.file package. Implement appropriate exception handling for file operations.
2. Develop a Java program using the ArrayList class to store, search, update, and delete student records through a menu-driven interface.

Suggested Learning Resources: (Text Book/ Reference Book/ Manuals):

Text books:

1. Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-Hill, ISBN: 9781260463422
2. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
3. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)
4. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.

Web links and Video Lectures (e-Resources):

- Java Tutorial: <https://www.geeksforgeeks.org/java/>
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): <https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/>
- Java Tutorial: <https://www.w3schools.com/java/>
- Java Tutorial: <https://www.javatpoint.com/java-tutorial>
- https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

1. While explaining each experiment, also focus on the application of that particular experiment in the electronics industry
2. In labs utilizing software programming, the emphasis must be on student understanding of the logic (e.g. pseudo-code) of the code, which libraries are required, which important functions calls need to be made and expected output. Faculty should not penalize students for making syntax errors in codes in the write up – however students must be able to debug the errors during program execution
3. Students should not memorize pin diagrams, these must be provided to the student during CIE and SEE
4. For record writing, faculty should ensure students write the main objective, design and procedure in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels. in their own words – and do not copy from manuals/online. Also, record writing should involve higher Blooms levels and not just Remember and Understand levels.

Self-learning (SL) components

Self-Learning (includes MOOCs, spoken tutorials, online educational resources etc.)

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	File Handling in Java	Mini-Project	https://docs.oracle.com/javase/tutorial/essential/io/?utm_source=chatgpt.com	2	VIVA

Community Project (Project-Based Learning) Societal Project			Credits	1
Course Code	25HUSE380	Course type	SDC	
Teaching Hours/Week (L:T:P:S)	0:0:0	Total Hours of Pedagogy in a semester	90 (00:00:00:30)	
CIE type	CCA	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	2	Total Marks	100	
Course outcome (Course Skill Set)				
At the end of the course, the student will be able to:				
1. CO1 (L2 – Understand): Identify and analyse societal problems through field interaction and technical assessment.				
2. CO2 (L3 – Apply): Develop skills in project planning, field survey, data collection, implementation, documentation, and reporting.				
3. CO3 (L4 – Analyse): Formulate feasible engineering problem statements and solutions considering practical constraints and sustainability aspects.				
4. CO4 (L3 – Apply): Apply principles of environmental responsibility, ethics, and societal welfare in engineering practice through community-oriented interventions.				
5. CO5 (L4 – Analyse): Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback, and baseline conditions.				
6. CO6 (L5 – Evaluate): Demonstrate teamwork and communication skills while interacting with technical and non-technical stakeholders, and reflect on the project's impact on society.				
Restrictions and professional conduct:				
Community / Societal Projects shall remain academic, socially responsible, technically focused, And politically neutral. Students and faculty shall maintain professionalism, ethical conduct, public respect and institutional integrity while interacting with communities, public groups, organizations and stakeholders.				
Students and faculty shall avoid the following during project execution:				
• Association with political party activities, campaigns or propaganda.				
• Participation in activities that may disturb communal harmony, public order or institutional reputation.				
• Use of the project platform for personal, political, ideological or commercial promotion.				
• Disrespectful, discriminatory or unethical interaction with community members or stakeholders.				
Projects must also recognise constraints related to cost, resources, environment, and safety, as well as stakeholder behaviour, cooperation, and acceptance when planning and implementing activities.				
Sustainable Development Goals				
The faculty shall encourage students to undertake community projects that align with and contribute towards satisfying the National Board of Accreditation (NBA) Criterion 3.6, namely,				

Evidence of Addressing Sustainable Development Goals (SDGs), which is a major emphasis of the United Nations (UN). The Sustainable Development Goals (SDGs) are illustrated in the figure shown below:



SET OF PROJECT ACTIVITIES

Number of hours: 0:0:0:30

Methods for Project Identification

Students may identify the project topic using one or more of the following methods:

- Interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.
- Review of issues highlighted in print and electronic media, and social networks (WhatsApp, Facebook, X, Instagram, etc.).
- After selecting a broad topic, students shall collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and then define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes

The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project Title	Measurable Engineering Outcome	Mapped POs	SDGs
1	Rural and Urban Water Conservation and Management Systems	Prepare a site-specific water conservation plan, estimate the water demand-supply gap, and propose a feasible conservation intervention with quantified water savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste Management and Recycling	Conduct a waste audit, classify waste streams, and design a segregation and recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13
3	Afforestation	Identify a degraded area, prepare a plantation layout, and	PO2, PO3, PO4, PO6,	SDG 11, SDG 13,

		demonstrate survival-rate tracking and a maintenance schedule for saplings.	PO7, PO11	SDG 15
4	Biogas Generation and Power Generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for Solar Power Plant in Rural Areas	Prepare a Detailed Project Report (DPR) with load assessment, panel sizing, cost estimation, projected energy generation, and payback analysis.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for Electrification of Village/Tribal Community	Map unserved or underserved households, propose an electrification layout, and estimate coverage, distribution losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for Rural Drainage System	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and Environmental Health Projects	Assess local environmental health issues and propose interventions with measurable improvements in hygiene, safety, or resource utilization.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic-Free Campaigns	Measure plastic usage before and after an awareness intervention and report the percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and Nutrition Awareness	Conduct baseline and post-program awareness surveys and document improvement in awareness scores or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal Projects Involving Health and Wellness	Identify a community health need and develop an awareness or service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air Quality Monitoring System	Collect air-quality data, compare it with reference limits, and present trends along with possible mitigation measures.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic Waste Reduction Campaign	Track collection, segregation, and replacement actions, and quantify the reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban Greening Projects	Prepare a greening plan, identify planting locations, and assess	PO2, PO3, PO4, PO6,	SDG 11, SDG 13,

		environmental benefits such as shade, aesthetics, and heat mitigation.	PO7, PO11	SDG 15
15	Smart Agriculture Solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water-use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart Irrigation System	Estimate crop water requirements, propose a control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Youth Mentoring Programmes	Deliver a structured mentoring activity and measure participation, engagement, and improvement in skills or awareness.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 17
18	Adult Education	Conduct a learner-needs assessment, prepare instructional content, and measure improvement in basic literacy or numeracy indicators.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 17
19	Food Security Initiatives / Cold Storage System	Estimate storage requirements, design a simple cold-chain concept, and document the reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12
20	Human Rights Awareness with Legal Systems	Prepare and deliver an awareness module and assess the increase in legal awareness and understanding of access to rights.	PO6, PO7, PO8, PO9, PO10	SDG 5, SDG 10, SDG 16
21	House Tax Collection through Digital Media	Develop a simple digital workflow or awareness support system and measure improvements in compliance, convenience, or response time.	PO2, PO3, PO4, PO5, PO10, PO11	SDG 9, SDG 11, SDG 16
22	Development of a Community Application / Mobile Application	Build or demonstrate a useful community application and measure usability, adoption, or efficiency improvement.	PO1, PO3, PO4, PO5, PO9, PO10	SDG 9, SDG 11, SDG 17
23	Creation of a Panchayat Library	Plan the library model, catalogue resources, and measure usage, accessibility, or community participation outcomes.	PO6, PO8, PO9, PO10, PO11	SDG 4, SDG 10, SDG 11, SDG 17