



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

IV 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)

IV 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	
				PSD		L	T	P	SL					
1	ASC	25MACC412	Mathematics for Machine Learning	TD- Maths PSB - Maths	42	0	0	48	90	3	50	50	100	3
2	IPCC	25ECIP420	Applied Computer Organization and Microcontrollers	TD: ECE PSB: ECE	42	0	28	50	120	3	50	50	100	4
3	PCC	25ECCC430	Control Systems	TD: ECE PSB: ECE	42	0	0	78	120	3	50	50	100	4
4	PCC	25ECCC440	Signals and Systems	TD: ECE PSB: ECE	42	0	0	48	90	3	50	50	100	3
5	PCCL	25ECCL450	Signals and Analog Communications Lab	TD: ECE PSB: ECE	0	0	28	02	30	2	50	50	100	1
6	AEC	25ECAE46X	Ability Enhancement Course Laboratory**	TD: ECE PSB: ECE	0	0	28	02	30	2	50	50	100	1
7	BSC	25HUCC472	Biology for Electrical and Electronics Engineers	Respective Dept.	28	0	0	32	60	3	50	50	100	2
8	SDC	25HUSE480	Environmental Science Project	Any Department/ Respective Engineering Dept.	0	0	0	30	30	3	50	50	100	1
9	PCC	25ECCC490	Introduction to Analog Communication	TD: ECE PSB: ECE	42	0	0	48	90	3	50	50	100	3



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			Systems											
10	NCMC	25HUNC491	National Service Scheme (NSS)	NSS Coordinator	0	0	0	28	28	---	100	---	100	PP
		25HUNC492	Sports and Athletics	Physical Education Director										
		25HUNC493	Yoga	Yoga Trainer										
		25HUNC494	Music	Music Teacher										
Total									688		550	450	1000	22
11	NCMC	25MANC400	Mathematics course for Lateral Entry Students	TD/PSB –Maths Dept	14	0	0	14	28	3	100	---	100	PP
Total									716		650	450	1100	22
		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 (Laboratory) – III

25ECAE461	Debugging and Fault Analysis of Analog and Digital Circuits	25ECAE463	Basics of Machine Learning Lab
25ECAE462	IOT lab	25ECAE464	Control Systems 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.			

Applied Computer Organization and Microcontroller			Credits	4
Course Code	25ECIP420	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: • CO1: Analyze computer organization, instruction execution, addressing modes, and evaluate system performance. • CO2: Evaluate I/O organization, interrupt handling, DMA operations, and cache memory design techniques. • CO3: Examine processing unit operations and assess pipelining performance and efficiency. • CO4: Understand and analyze ARM-based embedded system architecture, processor fundamentals, and basic embedded software development. • CO5: Apply ARM instruction set concepts for embedded programming and for different applications.				
Module-1			Number of hours: 8:0:0:10	
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance– Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes, Assembler directives Text book-1: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5,2.6.1				
Module-2			Number of hours: 8:0:0:10	
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions. Text book-1: 4.1, 4.2,4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1				
Module-3			Number of hours: 8:0:0:10	
Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. Pipelining: Basic concepts, Role of Cache memory, Pipeline Performance. Text book-1: 7.1, 7.2, 8.1				
Module-4			Number of hours: 10:0:0:10	
ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions. Text book-2: 1.1to 1.5, 2.1 to 2.5				
Module-5			Number of hours: 8:0:0:10	
Introduction to the ARM Instruction set:				

Introduction, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution. Text book-2: 3.1 to 3.9	
Practical Component	Number of hours: 0:0:28:0
S.No	Experiments
Faculty may choose between assembly level programming and higher-level language programming	
1	Write a program to i) multiply two 16-bit binary numbers. ii) add two 64-bit numbers.
2	Addressing Modes Demonstration (Immediate, Register, Indirect, Indexed)
3	Write a program to find factorial of a number.
4	Write a program to add an array of 16-bit numbers and store the 32-bit result in internal RAM.
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers.
7	Write a program to arrange a series of 32-bit numbers in ascending/descending order.
8	Write an assembly program using subroutines to perform arithmetic operations and demonstrate stack usage for parameter passing and return address storage
9	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10	LED interfacing and Timer Interrupt based LED control
11	Interface a DAC and generate Sine wave and Triangular waveforms.
12	Assembly program to measure instruction execution cycles using a timer/counter. Study the relationship between clock frequency, execution time, and processor performance.
Content Beyond Syllabus	
1	Generate PWM using the internal PWM module of ARM controller and vary its duty cycle
2	Demonstrate the use of external interrupt signal to toggle LED ON/OFF
Open Ended Experiment	
1	Measurement of ambient temperature using a sensor and SPI ADC IC
Suggested Learning Resources: (Textbook/ Reference Book/ Manuals): Textbooks: 1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5 th Edition, Tata McGraw Hill. 2. Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008. Web links and e-Resources: 1. https://nptel.ac.in/courses/106106092 2. https://nptel.ac.in/courses/106106166 3. https://nptel.ac.in/courses/106103180 4. https://nptel.ac.in/courses/108105102	
Teaching-Learning Process (Innovative Delivery Methods): 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. Concept Visualization and Demonstration: Use processor simulators, ARM development environments, and visual demonstrations to illustrate instruction execution, addressing modes, pipelining, cache memory operations, interrupts, and processor architecture.	

2. Hands-on Programming Activities: Conduct ARM assembly language programming exercises and embedded system application demonstrations to reinforce instruction set concepts, processor fundamentals, and embedded software development.

3. Application-Oriented Learning: Incorporate case studies and real-world examples from computer systems and embedded applications, such as IoT devices, consumer electronics, and industrial controllers, to connect theoretical concepts with practical implementations.

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	Computer Organization	Assignment	Textbook / PPT Notes	5	Assignment / Quiz
2	Memory System	Case Study on Cache Memory and Memory Hierarchy	NPTEL / Reference Book	5	Presentation /Quiz
3	Machine Instructions & programs	ALP Programming Exercises	Keil IDE	5	Program Execution/Quiz
4	Evolution of Computer Architecture	Assignment	Textbook / PPT Notes	5	Assignment / Quiz
5	Efficient C Programming	To implement microcontroller-based interfacing applications	Proteus / GitHub Projects	5	Project Demo/Report

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

Module No.	Topic	Self-Learning Activity	Resource / Link	No. of Hours	Assessment Method
1	Computer Input / Output Organization: Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB, Basic Processing Unit: Multiple Bus Organization, Hard-wired Control, Micro programmed Control.	Self-study, group discussion,	https://www.youtube.com/watch?v=Ln417iWAGL0 https://www.youtube.com/watch?v=hUdUfcDxVj0	5	Quiz / Viva / Assignment / Presentation
2	Memory System: Basic Concepts, Semiconductor RAM memories- Internal	Self-study, group discussion	https://www.youtube.com/watch?v=PujjqfUhtNo&list=PLBlnK6fEyqRjdT1xkkBZSXXwFKq	5	Quiz / Viva / Assignment / Presentation

	Organization of memory chips, static memories, Asynchronous DRAMs, ROMs, Virtual memories, Secondary Storage- Magnetic Hard Disks		QoYhwy https://www.youtube.com/watch?v=PujjqfUhtNo		
3	Machine Instructions & Programs: Assembly Language, Basic Input Output operations, Stacks and Ques, Subroutines, Additional Instructions	Self-study, group discussion	https://www.youtube.com/watch?v=vLHiVQKTg0&list=PL3R9-um41JszlOtyQCWly0WQNm30y3NMN	5	Quiz / Viva / Assignment / Presentation
4	Evolution of computer architecture: Microprocessor Vs Microcontroller, Harvard Architecture Vs. Von Neumann Architecture, RISC Vs CISC processor	Self-study, group discussion	https://www.youtube.com/watch?v=cNCpnQyeqGU	5	Quiz / Viva / Assignment / Presentation
5	Efficient C Programming: Overview of C Compilers and optimization, Basic C Data types, C looping structures.	Self-study, group discussion	https://www.youtube.com/watch?v=WYFzY9LKx0w	5	Quiz / Viva / Assignment / Presentation

Control Systems			Credits	4
Course Code	25ECCC430	Course type	PCC	
Teaching Hours/Week (L:T:P:S)	3: 2: 0: 4	Total Hours of Pedagogy in a semester	120 (42:28:00:50)	
CIE type	IA tests + CCA	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	

Course Objectives: This course will enable students to:

1. Analyze physical systems and their mathematical models using differential equations, transfer functions, and system analogies.
2. Evaluate the effect of feedback on control systems by examining block diagrams, signal flow graphs, and overall system behavior.
3. Analyze the time response characteristics and steady-state performance of first- and second order control systems, including the influence of basic controllers.
4. Assess the stability and relative stability of control systems using Routh–Hurwitz criterion and root locus techniques.
5. Analyze control system stability and performance in the frequency domain using Bode, Polar, and Nyquist plots.

Module-1	Number of hours: 9:6:0:15
Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs. Text Book T1: Chapter 1: 1.1,1.3,1.5,1.6, Chapter 2: 2.1, 2.2, 2.4, 2.5, 2.6, 2.7 Text Book T2: Chapter 3	
Module-2	Number of hours: 9:6:0:10
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design). Text Book T1: Chapter 5: 5.1, 5.2, 5.3, 5.4, 5.5 Text Book T2: Chapter 3	
Module-3	Number of hours: 8:6:0:07
Stability analysis: Concept of stability, necessary conditions for Stability, Routh- stability criterion, Relative stability criterion. Root-Locus Techniques: Root locus concepts, Construction of root loci, Stability of System. Text Book T1: Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.5; Chapter 7: 7.1, 7.2, 7.3 Text Book T2: Chapter 3	
Module-4	Number of hours: 8:5:0:10
Frequency domain analysis and stability using Bode plots: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Text Book T1: Chapter 8: 8.2, 8.4, 8.5, 8.6, 8.7 Text Book T2: Chapter 3	
Module-5	Number of hours: 8:5:0:08
Frequency domain analysis and stability: Introduction to Polar Plots, Mathematical preliminaries,	

Nyquist Stability criterion, Nyquist plots.

Text Book T1: Chapter 8: 8.1, 8.3, Chapter 9: 9.1, 9.2, 9.3

Suggested Learning Resources:

Books:

1. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International(P) Limited, Publishers, Fifth edition- 2005, ISBN: 81 - 224 - 2008-7.
2. Analysis and design of Control system using MATLAB by Rao V Dukkupati, New Age international (p) Limited Publishers,2006 Publication

Reference Books:

1. K. Ogata, "Modern Control Engineering," Pearson Education Asia/ PHI, 4th Edition, 2002.
2. K. Channa Venkatesh and D. Ganesh Rao, "Control Systems", Sanguine Technical Publishers.
3. Chi-Tsong Chen, "Analog and Digital Control System Design Transfer-Function, State-Space, and Algebraic Methods", OUP, 2006

Web links and e-Resources:

1. <https://nptel.ac.in/courses/107106081>
2. https://onlinecourses.nptel.ac.in/noc24_ee65/preview

Teaching-Learning Process (Innovative Delivery Methods):

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

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.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- 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 that topic in the succeeding classes.
- Give Programming Assignments.

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	Problems on Transfer Function, Analogous Systems	Assignment	https://www.tutorialspoint.com/control_systems/control_systems_feedback.htm	04	Assignment
	Block Diagram and SFG	Project Base Learning	https://nptel.ac.in/courses/107106081	04	Report
2	Implementation of Time domain Specifications and implementation of second order systems	Project Base Learning	https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm	04	Report
3	Problems on Stability and Root Locus	Assignment	https://nptel.ac.in/courses/107106081	04	Assignment
4	Design of Bode Plot	Project Base Learning	https://nptel.ac.in/courses/107106081 https://www.tutorialspoint.com/control_systems/control_systems_state_space_model.htm	04	Report
5	Design of Nyquist Stability Criterion, Polar Plots	Project Base Learning	https://nptel.ac.in/courses/107106081 https://www.tutorialspoint.com/control_systems/control_systems_state_space_model.htm	04	Report
Total				24 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	Introduction, Basics feedback systems, classification Applications of Control Systems.	Self-Study Virtual Lab	https://www.tutorialspoint.com/control_systems/control_systems_feedback.htm	02	Quiz
	Laplace Transform basic transfer functions, Poles and Zeros		https://www.youtube.com/watch?v=HcLYoCmWOjI&list=PLBlnK6fEyqRhqzJT87LsdQKYZBC93ezDo	02	Quiz
	Introduction to Block Diagram and Classifications, Basic elements	Self-Study Virtual Lab	https://www.tutorialspoint.com/control_systems/control_systems_block_diagrams.htm https://nptel.ac.in/courses/107106081	03	Quiz

2	Standard input signals, First order systems	Self-Study Virtual Lab	https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm https://nptel.ac.in/courses/107106081	03	Quiz
	Controllers and Classification of controllers		https://www.tutorialspoint.com/control_systems/control_systems_controllers.htm	03	Quiz
3	Basics of Stability. BIB stability. Closed-loop pole location and system stability	Self-Study Virtual Lab	https://www.tutorialspoint.com/control_systems/control_systems_stability.htm https://nptel.ac.in/courses/107106081	03	Quiz
4	Basics of Frequency Domain Analysis. Correlation between frequency and time domain analysis.	Self-Study Virtual Lab	https://www.tutorialspoint.com/control_systems/control_systems_frequency_response_analysis.htm	03	Quiz
	Basics of Compensation Networks, Lag, Lead and Lead-Lag Networks		https://www.tutorialspoint.com/control_systems/control_systems_compensators.htm	03	Quiz
5	Basics of Nyquist and Polar plot	Self-Study Virtual Lab	https://nptel.ac.in/courses/107106081 https://www.tutorialspoint.com/control_systems/control_systems_state_space_model.htm	04	Quiz
Total				26 Hours	

SIGNALS AND SYSTEMS			Credits	3
Course Code	25ECCC440	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. Apply knowledge of mathematics and Engineering fundamentals to Identify and characterize different classes of signals. 2. Compute the response and analyze the properties of an LTI system. 3. Analyze the signals in time and frequency domain for non-periodic signals. 4. Apply Fourier representations to analyze sampling process and mixed signals. 5. Apply ZT for broader characterization of discrete time signals and LTI systems.				
Module-1			Number of hours: 8:0:0:10	
Introduction: Definition of signals and systems, Mathematical Representation, Classification of signals, Operation on signals, Elementary signals, Systems viewed as interconnection of operations, Properties of systems. (Chapter 1 of Text Book 1)				
Module-2			Number of hours: 9:0:0:9	
Time Domain Representation of LTI Systems: Introduction, Impulse response representation of LTI systems, Properties of impulse response representation, Difference equation representation of LTI systems. (Sections 2.1 to 2.3 and 2.4 only Difference equation of Text Book 1)				
Module-3			Number of hours: 9:0:0:10	
Fourier representations for signals: Introduction, Orthogonality of complex sinusoids, Discrete Time non periodic signals: DTFT representation, Continuous Time non periodic signals: FT representation, Properties of Fourier transforms and DTFT. (Sections 3.1 to 3.5 of Text Book 1)				
Module-4			Number of hours: 8:0:0:10	
Applications of Fourier representations: Introduction, Frequency response of LTI systems, Fourier Transform representation of periodic signals, Fourier Transform representation of Discrete time signals, Sampling, reconstruction of continuous time signals. (Sections 4.1 to 4.3, 4.5 to 4.6)				
Module-5			Number of hours: 8:0:0:9	
Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform, Transform analysis of LTI systems, stability & causality, Unilateral Z-transform and its application. (Sections 6.1 to 6.7, 6.10)				
<u>Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):</u> <u>Textbooks:</u> Simon Haykin, Barry Van Ven, Signals and systems. Ed 2, John Wiley. Indian Ed, 2021. <u>Reference Books:</u> 1. H.P. HSU. Schaum's Outlines- Signals & Systems, Ed 2, TMH, 2010 2. Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, Signals & systems Ed 2, PHI, 2014				

Web links and e-Resources:

1. <https://nptel.ac.in/courses/117101055>
2. <https://nptel.ac.in/courses/117104074>

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	Assess ment Method
1	Simulink model to generate signals and perform addition, multiplication, time shifting, and time scaling	Project Based Learning	https://www.mathworks.com/help/simulink/signal-processing-and-communications.html	4	Report
2	Problems on LTI system	Assignm ent	-	4	Assignm ent
3	Problems on FT/DTFT	Assignm ent	-	4	Assignm ent
4	Simulink model to analyze the frequency spectrum of different signals (sine,	Project Based Learning	https://www.mathworks.com/help/simulink/signal-processing-and-communications.html	4	Report

	square and composite) using the Spectrum Analyzer				
5	Problems on Z-transform	Assignment	-	4	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	Application of Systems and signal analysis	Self-study	https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-2-signals-and-systems-part-i/ https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-3-signals-and-systems-part-ii/ https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-19-discrete-time-sampling/ https://www.tutorialspoint.com/signals_and_systems/signals_analysis.htm	6	Quiz
2	Systems represented by differential equations	Self-study	https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-6-systems-represented-by-differential-equations/ https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-4-convolution/	5	Quiz
3	Basics of Fourier Transform and applications	Self-study	https://www.youtube.com/watch?v=gZNm7L96pfY	6	Quiz
4	Continuous Time Fourier series, Discrete Time Fourier Series	Self-study	https://www.khanacademy.org/science/electrical-engineering/ee-signals?utm_source https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-7-continuous-	6	Quiz

			time-fourier-series/ https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-10-discrete-time-fourier-series/		
5	Laplace Transform mod 5	Self-study	https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/resources/lecture-20-the-laplace-transform/	5	Quiz

SIGNALS AND ANALOG COMMUNICATION LAB			Credits	1
Course Code	25ECCL450	Course type	PCCL	
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	2	Total Marks	100	
Course Outcomes: At the end of the course the student will be able to: 1. Apply knowledge of mathematics and Engineering fundamentals to Identify and characterize different classes of signals. 2. Compute the response and analyze the properties of an LTI system. 3. Analyze the signals in time and frequency domain for non-periodic signals. 4. Understand the basic concepts of AM and FM modulation and demodulation. 5. Design and analyse the electronic circuits for modulation and demodulation circuits.				
Note: 1. The laboratory syllabus consists of PART-A and PART-B. While PART-A has 8 conventional experiments, PART-B has 3 typical open-ended experiments. The maximum marks for the laboratory course are 100. 2. Both PART-A and PART-B are considered for CIE and SEE. 3. Students have to answer 1 (one) question from PART-A and 1 (one) question from PART-B. 4. The questions set for SEE shall be from among the experiments under PART-A. It is evaluated for 70 marks out of the maximum 100 marks. 5. The open-ended question set for SEE shall be any other open-ended question and not selected from the experiments under PART-A. It shall be evaluated for 30 marks. 6. For Continuous Internal Evaluation (CIE) during the semester, classwork shall typically include open-ended questions from Part-B, along with other similar questions designed to enhance the students' skills.				
Part A Conventional Experiments			Number of hours: 0:0:20:0	
1. Generation of Sinusoidal Signal and Energy Computation of Real and Complex Signals 2. Response Calculation of Discrete LTI System Using Convolution 3. Frequency Domain Representations of Single-Tone and Multi-Tone Sinusoidal Signals 4. Sampling Theorem Verification and Plotting Spectrum of Discrete-Time Signals. 5. Design a frequency modulator using a VCO and an FM demodulator using a PLL. 6. Design and plot the frequency response of pre-emphasis and de-emphasis Circuits. 7. Design and test a BJT/FET mixer. 8. Design and test pulse sampling, flat-top sampling, and reconstruction. 9. Design and Test Pulse Amplitude Modulation and Demodulation. 10. Generation and Detection of Pulse Position Modulation and Pulse Width Modulation.				
Part B Open-ended experiments			Number of hours: 0:0:8:0	
Open-ended experiments are a type of laboratory activity where the outcome is not predetermined and students are given the freedom to explore, design, and conduct the				

experiment based on the problem statements as per the concepts defined by the course coordinator. It encourages creativity, critical thinking, and inquiry-based learning. 1. Test the Balanced Modulator / Lattice Modulator 2. Develop a MATLAB program to generate the Fourier Series representation of a square wave and investigate the effect of varying the number of harmonics on the waveform approximation. 3. Calculating transforms using MATLAB. a. Calculate and plot Fourier transform of a given signal. b. Calculate and plot Z-transform of a given signal.
Content Beyond Experiments 1. Design an amplitude modulator/demodulator using discrete components. 2. Design a MATLAB-based simulation to acquire, sample, and reconstruct a signal using different sampling rates. 3. Develop a MATLAB program to generate and analyze the frequency spectrum of user-defined single-tone and multi-tone sinusoidal signals.
Suggested Learning Resources: (Text Book/ Reference Book/ Manuals): Text books: 1. Simon Haykin, Barry Van Ven, Signals and systems. Ed 2, John Wiley. Indian Ed, 2008. 2. Louis E Frenzel, Principles of Electronic Communication Systems, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6. Web links and e-Resources: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee28 https://nptel.ac.in/courses/107106081
Teaching-Learning Process (Innovative Delivery Methods): • Assignment-based learning using MATLAB simulations. • Online quizzes and concept-based assessments.

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	Implementation of interpolation and decimation concepts.	Self-study	https://www.scribd.com/doc/196026867/3	2	Viva

Debugging and Fault Analysis of Analog and Digital Circuits (KiCad with ngspice)			Credits	1
Course Code	25ECAE461	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. Read and analyse datasheets of various analog and digital ICs. 2. Understand the working of various analog and digital equipment and instruments. 3. Find the faults in various analog and digital equipment and instruments. 4. Debug faults in various analog and digital equipment and instruments.				
Set of Experiments			Number of hours: 0:0:28:0	
1	Data Sheet Reading: Understanding the Electrical/Mechanical/Thermal Characteristics, Absolute Maximum Ratings.			
2	Digital Multimeters: Digital Multimeters and LCR Meters - Resolution, Measurements of Voltage (Range), Current (Range), AC, DC, RMS values, Ave values, Ripple, Measurements of Frequency, Measurement of R, Diode, Transistor, SCR, MOSFET etc., Buzzer Mode, Using special probes to measure temperature, excite few RLC, fuse wire etc., with destructive and non-destructive tests, along with the help of scope and power supply.			
3	Power Supplies: Setting up the power supply for output, voltage settings, resolution, current limit setting, tracking mode, float ground, common ground, over loading effect on power supplies, isolated ground in dual or triple output power supplies, output noise measurements, rise time, fall time and ripple.			
4	Signal Generators: Understanding the signal generators - Resolution, amplitude, frequency settings, waveform generation, modulating two channels to get various other kinds of waveforms from DC to 500 kHz, measure the same with scope and confirm the read value, connect a few RLC circuits to observe the waveform characteristics.			
5	Finding fault and debugging 555-Timer based Industry Application based circuit.			
6	Finding fault and debugging 12 Volts fixed and variable voltage power supply.			
7	Finding fault and debugging of domestic use stabilizer.			
8	Finding fault in an inverter circuit.			
9	Debugging Bluetooth audio amplifier board.			
10	Debugging of mobile phones.			
11	Finding fault in a BJT amplifier Q-point drift.			
12	Finding fault in a combinational stuck at logic probe.			
13	Debugging the glitch in the counter.			
14	Debugging FM Radio Receiver Board.			
15	Finding fault in BS6 automotive sensors using appropriate OBD scanner.			
Content Beyond Syllabus				
1	Fault Analysis of an LED Blinking circuit using 555 Timer			
Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):				

Textbooks:

1. Horowitz P. and Hill W., The art of Electronics, 3rd Edition, Cambridge University Press, 2015.
2. Pease R. A., Troubleshooting Analog Circuits, 2nd Edition, Newnes/Elsevier, 2013.

Reference Books:

1. Electronic Principles, Albert Paul Malvino and David Bates, 8th Edition, McGraw-Hill Education, 2015.
2. Practical Electronics Handbook, Ian Sinclair, 7th Edition, Newnes (Elsevier), 2011.

Web links and e-Resources:

Tektronix Inc., The XYZs of Oscilloscopes, 7th Edition, Tektronix Publications, Beaverton, USA, 2020, https://download.tek.com/document/03W_8605_7_HR_Letter.pdf

(This link is to help faculty and students understand how oscilloscopes function, the different features and how to troubleshoot. The same manual can be used for any brand of oscilloscopes, the principles remain the same)

Teaching-Learning Process (Innovative Delivery Methods):

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

1. Problem-based learning through circuit fault diagnosis and troubleshooting tasks.
2. Simulation-based debugging using KiCad/ngspice and Logisim Evolution for analog and digital circuits.
3. Simulation-to-hardware approach by comparing simulated faults with practical circuit faults.
4. Signal tracing method to identify faults in RC circuits, rectifiers, transistor circuits, op-amp circuits, logic gates, and sequential circuits.
5. Instrument-oriented learning using DMM, CRO/DSO, logic probe, and logic analyser for fault localization.
6. Fault insertion and rectification activities involving open circuits, short circuits, wrong polarity, incorrect component values, floating inputs, and stuck-at faults.
7. Case-study-based learning for mixed-signal sensor interface systems and PCB-level fault diagnosis.
8. Collaborative troubleshooting exercises to improve analytical thinking, teamwork, and debugging skills.
9. Documentation-based learning through preparation of troubleshooting reports, fault tables, observations, and corrective actions.
10. Self-learning activity through design of a fault diagnosis trainer or troubleshooting guide.

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	Fault Diagnosis Trainer / Troubleshooting Guide for Analog Circuit	Identify and troubleshoot faults in an analog circuit.	KiCad_SPICE ngspice_Docs Circuit Troubleshooting Logic Gate Simulation Oscilloscope Basics	2	Circuit design, fault identification, diagnostic procedure, rectification, report, and viva.
2	Fault Diagnosis Trainer / Troubleshooting Guide for Digital Circuit	Identify and troubleshoot faults in digital logic circuits.			Logic circuit design, fault analysis, output verification, troubleshooting report, and viva.
3	Mixed-Signal Sensor Interface Fault Diagnosis	Diagnose faults in a simple sensor interface system.			Fault localization, instrument usage, rectification, case study documentation, and viva.

IoT (Internet of Things) Lab			Credits	1
Course Code	25ECAE462	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. Explain the Internet of Things and its hardware and software components.
2. Interface I/O devices, sensors & communication modules.
3. Remotely monitor data and control devices.
4. Develop real-life IoT-based projects.

Set of Experiments	Number of hours: 0:0:28:2
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- 1.(a) To interface LED/Buzzer with Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds.
(b) To interface Push button/Digital sensor (IR/LDR) with Raspberry Pi and write a program to 'turn ON' LED when push button is pressed or at sensor detection.
(c)To interface motor using relay with Raspberry Pi and write a program to 'turn ON' motor when push button is pressed.
2. (a) To interface DHT11 sensor with Raspberry Pi and write a program to print temperature and humidity readings.
(b) To interface OLED with Raspberry Pi and write a program to print temperature and humidity readings on it
3. (a) Write an Arduino/Raspberry Pi program to interface the Soil Moisture Sensor.
(b) Write an Arduino/Raspberry Pi program to interface the LDR/Photo Sensor
4. (a) Write a program to interface an Ultrasonic Sensor with Raspberry Pi.
(b) Write a program to interface an IR sensor with Raspberry Pi.
5. (a) Write a program on Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
(b) Write a program on Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
6. Write a program to interface LED using Telegram App
7. (a) Write a program on Raspberry Pi to publish temperature data to MQTT broker.
(b) Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it
8. (a) Write a program to create TCP server on Raspberry Pi and respond with temperature and humidity data to TCP client when requested.
(b) Write a program to create UDP server on Raspberry Pi and respond with temperature and humidity data to 2 UDP client when requested.
9. (a) Write a program to interface Bluetooth with Raspberry Pi and turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
(b)Write a program to interface Bluetooth with Raspberry Pi and send sensor(IR/LDR) data to smartphone using Bluetooth
10. Write a program to interface servo motor to Raspberry Pi using PWM control.
11. Write a program to interface fingerprint sensor with Raspberry Pi to (a) Enroll a user (b) Authenticate the user (c)Delete a user

12. Write a program to interface RFID module with Raspberry Pi to read and write the information.
13. To install MySQL database on Raspberry Pi and perform basic SQL queries.
14. (a) Develop a Python program to interface a temperature sensor with Raspberry Pi and log the temperature readings into an SQLite3 database.
- (b) Develop a Python program to retrieve stored temperature readings from an SQLite3 database and print the values on the console

Content Beyond Syllabus

1. Write an Arduino sketch to display a custom 128x64 bitmap image on an SSD1306 I2C OLED display.

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

Textbooks:

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things. "A Hands on Approach", University Press.
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

Web links and e-Resources:

- <https://nptel.ac.in/courses/106105166>

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	Automated Hydroponic system	Self-study	https://kylegabriel.com/projects/2020/06/automated-hydroponic-system-build.html#more-1971	2	Viva

Basics of Machine Learning Lab			Credits	1
Course Code	25ECAE463	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 machine learning algorithms to real life problems.				
2. Able to make use of different machine learning approaches.				
3. Able to down load different datasets and analysing the signals.				
4. Able to apply different denoising techniques to time series and image signals.				

SET OF EXPERIMENTS	Number of hours: 0:0:28:0
1. Solve the Tic-Tac-Toe problem using the Depth First Search technique. 2. Show that the 8-puzzle states are divided into two disjoint sets, such that any state is reachable from any other state in the same set, while no state is reachable from any state in the other set. 3. To represent and evaluate different scenarios using predicate logic and knowledge rules. 4. To apply the Find-S and Candidate Elimination algorithms to a concept learning task and compare their inductive biases and outputs. 5. To construct a decision tree using the ID3 or KNN algorithm on a simple classification dataset. 6. To assess how the ID3 algorithm performs on datasets with varying characteristics and complexity, examining overfitting, underfitting, and decision tree depth. 7. To examine different types of machine learning approaches (Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning) by setting up a basic classification problem and exploring how each type applies differently. 8. To understand how Find-S and Candidate Elimination algorithms search through the hypothesis space in concept learning tasks, and to observe the role of inductive bias in shaping the learned concept. 9. To go through all stages of a real-life machine learning project, from data collection to model fine-tuning, and dimensionality reduction using a regression dataset like the "California Housing Prices." 10. To perform binary and multiclass classification on the MNIST dataset, analyze	

performance metrics, and perform error analysis.

11. Applying different denoising techniques and analyzing the time series signals.

12. Applying different denoising techniques to images and analyzing them.

Content Beyond Syllabus

1. Implement the K-Nearest Neighbors (KNN) algorithm using the Iris dataset to classify flower species and evaluate the classification accuracy.

2. Implement a Decision Tree classifier using the Iris dataset available in Scikit-learn, classify the flower species, and evaluate the model using accuracy and a confusion matrix.

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

Text books:

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson, 2015
2. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2013.
3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
4. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & Tensor Flow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/106106139>
- <https://nptel.ac.in/courses/106105152>

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	Handwritten	Mini-Project	https://scikit-	2	VIVA

	Digit Recognition Using a Pre- trained Model		learn.org/stable/auto_exam ples/classification/plot_dig it_s_classification.html?utm_so urce=chatgpt.com		
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Control Systems Lab			Credits	01
Course Code	25ECAE464	Course type	AEC (Lab)	
Teaching Hours/Week (L:T:P:S)	0: 0: 2: 0	Total Hours of Pedagogy in a semester	30 (0:0:28:2)	
CIE type	Lab CIE + Lab Test	CIE Marks	50	
SEE Examination type	Practical	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. Understand basics of control systems and design mathematical models using block diagram reduction
2. Understand time domain and frequency domain analysis.
3. Analyze the stability of a system from the transfer
4. Develop mathematical model of a motor and generator.

SET OF EXPERIMENTS	30 (0:0:28:2)
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MATLAB/ Scilab/ Octave/ Open-source tool can be used for simulation.

1. Implement Block Diagram Reduction Technique and Signal Flow Graph to Obtain Transfer Function a Control System.
2. Simulation of Poles and Zeros of a Transfer Function.
3. Implement Frequency Response of a Second Order System.
4. Implement Frequency Response of a Lead Lag Compensator.
5. Analyze the Stability of the Given System Using Routh Stability Criterion.
6. Analyze the Stability of the Given System Using Root Locus.
7. Analyze the Stability of the Given System Using Bode Plot.
8. Analyze the Stability of the Given System Using Nyquist Plot.
9. Obtain the Time Response from State Model of a System.
10. Stability Analysis of Linear Time Invariant Systems using Matlab
11. Develop a Mathematical Model of DC Motor/ Generator
12. Develop a Mathematical Model of Servo Motor

Content beyond Experiments:

1. Using Suitable simulation package study of speed control of DC motor using Armature control method.
2. Implement various compensators using Simulink

Suggested Learning Resources:

Books:

1. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International(P) Limited, Publishers, Fifth edition- 2005, ISBN: 81 - 224 - 2008-7.
2. Analysis and design of Control system using MATLAB by Rao V Dukkupati, New Age international (p) Limited Publishers,2006 Publication

Web links and e-Resources:

<https://nptel.ac.in/courses/108106098>

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. Students should not memorize pin diagrams; these can be provided to the student during CIE and SEE

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

Module No.	Topic	Term work Activity	Resource / Link	No. of Hours	Assessment Method
1	Design of various types of Controllers	Simulation of various types of Controllers using MATLAB and SIMULINK	MATLAB Software and Mathworks	02	MATLAB Code, SIMULINK Model, simulation output, brief report, and viva.
Total				02 Hours	

Environmental Science Project			Credits	1
Course Code	25HUSE480	Course type	AEC	
Teaching Hours/Week (L:T:P:S)	0:0:0:0	Total Hours of Pedagogy in a semester	30 (00:00:00:30)	
CIE type	Lab CIE + Lab test	CIE Marks	50	
SEE Examination type	Practical	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	

Course Objectives

The **Environmental Science Project** is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real-world issues such as climate change, pollution, biodiversity, resource utilization, soil erosion, and thermal comfort through field surveys, case studies, data collection, environmental audits, and analysis to develop feasible and sustainable solutions. Students may work individually or in groups of up to four members, including interdisciplinary topics. Assessment shall be carried out based on the prescribed rubrics.

Course Outcomes (Course Skill Set)

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

1. **CO1 (L2 – Understand):** Identify and analyse environmental 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 – Analyze):** Formulate feasible environmental 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 – Analyze):** 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

Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty shall maintain professionalism, ethical conduct, and respect while working with communities and stakeholders. They shall avoid any political, ideological, commercial, or disruptive activities.

Projects should also consider practical constraints related to **cost, resources, safety, environmental impact, and stakeholder cooperation** during planning and implementation.

Set of Project Activities (TW/SL = 30 Hours)

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 networking platforms.
- After selecting a broad topic, collect relevant data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and clearly define the problem statement and project objectives.

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 demonstrate survival-rate tracking and a maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, 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 with reference limits, and present trends along with possible mitigation suggestions.	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 environmental benefits such as shade, aesthetics, and heat mitigation.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, 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	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

Introduction to Analog Communication Systems			Credits	3
Course Code	25ECCC490	Course type	PCC	
Teaching Hours/Week (L:T:P:S)	3:0:0	Total Hours of Pedagogy in a semester	90 (42:00:00:48)	
CIE type	IA tests + CCA	CIE Marks	50	
SEE Examination type	Theory	SEE Marks	50	
SEE Exam Hours	3	Total Marks	100	

Course outcome (Course Skill Set)

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

1. Apply the concepts of random variable and random process to model communication systems.
2. Apply concepts of analog modulation and demodulation schemes.
3. Apply the electronic circuits for modulation and demodulation.
4. Apply the concepts of digitization of signals.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. 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.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	Number of hours: 8:0:0:5
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Random Variables and Processes: Introduction, Probability, Conditional Probability, Random variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross-correlation functions, Gaussian Process: Gaussian Distribution Function.

Text book 2: 5.1, 5.2,5.3,5.4,5.5,5.6,5.9

Module-2	Number of hours:9:0:0:12
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Amplitude Modulation Fundamentals: AM Concepts, Modulation index and Percentage of Modulation, Sidebands and the frequency domain, AM Power, Single Sideband Modulation. AM Circuits: Amplitude Modulators: Diode Modulator (Exclude Transistor Modulator and Differential Amplifier), collector Modulator. Amplitude Demodulators: Diode Detector (Exclude Crystal Radio Receivers & Synchronous Detection), Balanced Modulators: Lattice Modulators.

(Exclude IC Balanced Modulators) Frequency Division Multiplexing: Transmitter-Multiplexer, Receiver-Demultiplexer. Text book 1: 3.1, 3.2,3.3,3.4,3.5,4.2,4.3,4.4,10.2	
Module-3	Number of hours: 9:0:0:12
Fundamentals of Frequency Modulation: Basic Principles of Frequency Modulation, Principles of Phase Modulation, Modulation index and sidebands, Noise Suppression Effects of FM, Frequency Modulation versus Amplitude Modulation. FM Circuits: Frequency Modulators: Voltage Controlled Oscillators. Frequency Demodulators: Slope Detectors, Phase Locked Loops. Communication Receiver: Super heterodyne receiver, Frequency Conversion: Mixing Principles, Simple diode Mixer. Text book 1: 5.1,5.2,5.3,5.4,5.5,6.1,6.3,9.2,9.3	
Module-4	Number of hours: 8:0:0:10
Digital Representation of Analog Signals: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time-Division Multiplexing, Pulse Position Modulation: Generation and Detection of PPM wave. The Quantization Process. Pulse Code Modulation: Sampling, Quantization, Encoding, line Codes, Differential encoding, Regeneration, Decoding, filtering, multiplexing. Text book 2: 7.1,7.2,7.3,7.4,7.5,7.6,7.8,7.9	
Module-5	Number of hours: 8:0:0:9
Baseband Transmission of Digital signals: Introduction, Inter symbol Interference, Eye Pattern, Nyquist criterion for distortion less Transmission, Baseband M-ary PAM Transmission. Text book 2:8.1,8.4,8.5,8.6,8.7 Noise: Signal to Noise Ratio, External Noise, Internal Noise, Semiconductor Noise, Expressing Noise Levels, Noise in Cascade Stages. Text book 1:9.5	
Suggested Learning Resources: Books 1. Louis E Frenzel, Principles of Electronic Communication Systems, 3rd Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-0-07-066755-6. 2. Simon Haykin & Michael Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN: 978-81-265-2151-7. Reference books / Manuals: 1. B P Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems", Oxford University Press., 4th edition, 2010, ISBN: 97801980738002. 2. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication systems", 4th Edition, Mc Graw Hill Education (India) Private Limited, 2016. ISBN: 978-1-25-902985-1 Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/108104091 • https://nptel.ac.in/courses/117102059	
Teaching-Learning Process (Innovative Delivery Methods): These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.	

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	As mentioned by the subject coordinator	Case Study	--	15	Presentation
2	As mentioned by the subject coordinator	Quiz	---	5	Quiz
				20 Hours	

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

Module No.	Topic	Self-Learning Activity	Resource / Link		Assessment Method
1	PSD of random process	Self-Study	https://youtu.be/jglXZA7Ti0Q?si=VBRG7Vtw0-Tv58mX	02	Quiz
	Gaussian random Process & White Noise		https://youtu.be/xs2de3YBgZM?si=5rf18WH6LJkA70Sm	02	
2	Need for Modulation & Communication System Basics	Self-Study	https://youtu.be/K-KSEnFWnwE?si=m5qOPR0z8qlASPdb	02	
	Wave Propagation		https://youtu.be/0nr4I5zkj9Y?si=xfY3BU66ncl9oAzzx	02	
3	Bandwidth of FM Carson's Rule	Self-Study	https://youtu.be/dgPCyrwj1Y?si=HuqHGxCa1Fj-7ZQB	02	Quiz
	Bessel Functions in FM		https://youtu.be/8gVXtFuigFI?si=RI7zDgZImNOdKCD5	02	
	Armstrong Method for indirect FM		https://youtu.be/hhto6WRgl1g?si=_vXJOBIa8PdZynnn	02	
4	Multiplexing & Multiple access techniques	Self-Study	https://youtu.be/951kYJpozrk?si=j11IJYu0B5RYujVE	02	Quiz
	Performance Comparison of PAM, PWM and PPM		https://youtu.be/90dizh1SI3E?si=LuGkssBznA-gd_3T	02	
	PWM & PPM generation using OPAMP		https://youtu.be/DMwTgx70BJE?si=qW70Vss0DknbtDxy	02	
			https://youtu.be/YM4Kmyu3gVs?si=WO47p5DLt4w8iaXY		
5	A- Law & μ Law Companding	Self-Study	https://youtu.be/whvSJEEgO4w?si=9mYgkLaxwy3hODKH	02	Quiz
	T1 carrier systems		https://youtu.be/kx5rEYUiKJo?si=FPp9mtj1JfINDf6G	02	
	Speech Signal Processing Basics		Reference 1 (Section 6.8)	02	
	DPCM TX & Rx		https://youtu.be/q_f1qB4UeQM?si=69m0nETje68ljGjt	02	
				28 Hours	