SIDDAGANGA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME & SYLLABUS

OF

III & IV SEMESTER

B.E.

Electronics & Telecommunication Engg.

2024 - 25

Vision of the Dept.:

To become center of excellence in Electronics & Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

Mission of the Dept.

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)

The graduates of Electronics & Telecommunication Engineering are able to:

- Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Telecommunication Engineering and allied disciplines.
- Pursue higher education by lifelong learning in the areas of Telecommunication Engineering and allied disciplines.
- Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

Program Outcomes (POs):

1: Engineering Knowledge, 2: Problem analysis, 3: design/development of solutions, 4: conduct investigations of complex problems, 5: Engineering tool usage, 6: The engineer and The world, 7: Ethics, 8: Individual and Collaborative team work, 9: communication, 10: project management and finance, 11: Life-Long learning

PROGRAM SPECIFIC OUTCOMES (PSOs):

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.
- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' grade & ISO 9001:2015 Certified)

B.E. in ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION NEP-2

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs.				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	SSC/ SDA	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC / BSC	S3ETMAT	Mathematical foundations for communication systems	ETE	42	0	0	48	3	50	50	100	3
2.	IPCC	S3ETI01	Signals and Systems	ETE	42	0	28	50	3	50	50	100	4
3.	IPCC	S3CESI1	Digital Electronic Circuits with Verilog	ETE	42	0	28	50	3	50	50	100	4
4.	PCC	S3CES2	Analog Electronic Circuits	ETE	42	0	0	48	3	50	50	100	3
5.	PCCL	S3ETL01	Analog Electronic Circuits Laboratory	ETE	0	0	28	2	3	50	50	100	1
6.	ESC	S3ETESCx	ESC/ETC/PLC	ETE	42	0	0	48	3	50	50	100	3
7.	UHV	SHS01	Social Connect and Responsibilities**(Board: ME)**	ETE	0	0	28	2	-	100	-	100	1
8.	AEC/ SEC	S3ETAx	Ability Enhancement Course/ Skill Enhancement Course – III Arduino/Raspberry pi based micro projects	ETE	If offered as Theory Course				3	50	50	100	1
					If offered as Lab Course								
					0	0	28	02					
9.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	-	-	-	-	-	100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga and Pranayama	PED									
		SMC04	National Cadets Corps	NCC									
			Total						**21**	**550**	**350**	**900**	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **PCC**: Professional Core Course, **IPCC**: Integrated Professional Core Course, **PCCL**: Professional Core Course laboratory,
UHV: Universal Human Value Course, **NCMC**: Non Credit Mandatory Course, **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course,
ESC: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course **SSC:** Self Study Component
L: Lecture, **T**: Tutorial, **P**: Practical **S= CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **SDA**: Skill Development Activity

Engineering Science Course (ESC/ETC/PLC) (Offered by the Department)

S3ETESC02	Numerical Methods in Engineering	S3ETESC04	Operating Systems
S3ETESC03	Sensors and Instrumentation	S3ETESC05	Data Structures using C

Ability Enhancement Course – III (Offered by the Department)

S3ETA01	Arduino/Raspberry pi based micro projects	S3ETA02	LabVIEW Simulations
S3ETA03	Embedded C Basics Programming	S3ETA04	Signal Processing Lab

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B.E. in ELECTRONICS & TELECOMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION NEP-2

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture L	Tutorial T	Practical/ Drawing P	SSC/ SDA S	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1.	PCC	S4ET01	Principles of Communication Systems	ETE	42	0	0	48	3	50	50	100	3
2.	IPCC	S4CESI01	Control Systems	ETE	42	0	28	50	3	50	50	100	4
3.	IPCC	S4CESI02	ARM Microcontroller	ETE	42	0	28	50	3	50	50	100	4
4.	PCCL	S4ETL01	Communication Systems Lab	ETE	0	0	28	2	3	50	50	100	1
5.	ESC	S4ETESCx	ESC/ETC/PLC	ETE	42	0	0	28	3	50	50	100	3
6.	BSC	S4CCA01	Biology for Engineers **(Board: BT)**	BT	42	0	0	28	3	50	50	100	3
7.	UHV	SHS02	Universal Human Values Course **(Board: IEM)**	ETE	14	0	0	16	1½	50	50	100	1
8.	AEC / SEC	S4ETAx	Ability Enhancement Course/ Skill Enhancement Course	ETE	If offered as Theory Course				3	50	50	100	1
					If offered as Integrated Course								
					0	0	28	2					
9.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	-	-	-	-	-	100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
		SMC04	National Cadets Corps	NCC									
			Total						**22.5**	**500**	**400**	**900**	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **PCC**: Professional Core Course, **IPCC**: Integrated Professional Core Course, **PCCL**: Professional Core Course laboratory,
UHV: Universal Human Value Course, **NCMC**: Non Credit Mandatory Course, **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course,
ESC: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **SSC:** Self Study Component
L: Lecture, **T**: Tutorial, **P**: Practical **S= CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation, **SDA**: Skill Development Activity.

Engineering Science Course (ESC/ETC/PLC) (Offered by the Department)

S4ETESC01	Fields, Waves and Transmission Lines	S4ETESC02	Electronic Devices
S4ETESC03	PCB Design	S4ETESC04	Engineering Statistics and Linear Algebra

Ability Enhancement Course – IV (Offered by the Department)

S4CCA02	ATT lab	S4ETA03	Data Structures Lab using C
S4ETA01	System design using Verilog	S4ETA04	Circuit Analysis

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE(no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2022-23 may please be referred.

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.

MATHEMATICAL FOUNDATIONS FOR COMMUNICATION SYSTEMS

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3ETMAT	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Acquire foundational knowledge of mathematical tools including Laplace transforms, Fourier transforms, probability theory, random processes, and vector calculus operations.
2.	Apply these mathematical tools to analyze and solve engineering problems effectively.
3.	Utilize Laplace and Fourier transforms for signal analysis, probability theory for modeling uncertainties, and vector calculus operations for understanding fields and fluxes in engineering contexts.

UNIT I

Fourier Transformation and Applications: Introduction to Fourier Transform, Properties of Fourier Transform, Inverse Fourier transformation using Partial fraction expansion. **Applications:** Fourier transform of periodic signals, Application of Fourier transformation to find frequency response and impulse response of continuous time LTI systems, Applications of Fourier transformation to solve linear constant-coefficient differential equations, Application of Fourier transformation to Electric circuit analysis. Analysis of signals and their Fourier transform using MATLAB Simulink and AWR Simulation Tool.

10 Hours

UNIT II

Laplace Transform and Applications: Introduction, The Laplace transform, Region of convergence for Laplace transforms, Properties of Laplace transform, Inverse Laplace transform by using Partial fraction expansion. **Applications:** Laplace transform in Electric circuits analysis: transfer function, Causality and stability, Laplace transform to find frequency response and impulse response of continuous time LTI systems, Determining the frequency response from poles and zeros, Applications of Laplace transform to solve linear constant-coefficient differential equations. Zero-Pole Analysis using MATLAB & Simulink

8 Hours

UNIT III

Set theory: Basic concepts of set theory, defining sets, Venn diagram and subsets, set operations, De Margan's Laws, problems solving using set theory. **Probability:** Sample space, Field, Events, Introduction to probability, Axiom's of probability, elementary properties of probability, problems solving. Addition rule of probability, Conditional probability, properties of conditional probability, problems solving

8 Hours
UNIT IV
Probability: Product rule (Multiplication rule) of probability, problems solving. Total probability, problems solving. Bayes Theorem, problems solving on Bayes theorem. Properties of independent events. **Introduction to Random variables**: Classification of random variables- discrete and continuous random variables, examples. Probability density function (pdf), properties of pdf. Mean, Variance, and standard deviation calculations
8 Hours
UNIT V
Vector Calculus: Introduction vector calculus, Differential Length, Area, and Volume, Line, Surface, and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Laplacian of a Scalar
8 Hours

TEXT BOOKS		
1	Alan V. Oppenheim ,Alan S. Willsky and S. Hamid Nawab	"Signals & Systems", 2nd Ed, Pearson Prentice Hall, 2013
2	Johnson. R.A., Miller. I.R and Freund. J.E,	"Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
3	Simon Haykin	"An introduction to Analog and Digital communications", Wiley India, 2nd edition, 2006.
4	Matthew N O Sadiku	"Elements of Electromagnetics". Ed 4. Oxford Univ. Press. 2007

REFERENCE BOOKS		
1	Simon Haykin and Barry Van Veen	"Signals and Systems" 2nd Ed, John Wiley, 2007
2	William H Jr. Hayt and John A Buck	"Engineering Electromagnetics" Ed 7. Tata McGraw-Hill. 2006.
3	B.S.Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply Fourier transform and inverse Fourier transform to analyze the response of LTI systems in frequency and time domain
CO2	Compute the Laplace transform and Inverse Laplace transform of functions and apply Laplace transform to analyze the response of LTI systems
CO3	Analyze the nature of the events and hence determine the appropriate probabilities of the events
CO4	Analyze the nature of random variables through mean, variance and standard deviation
CO5	Apply the vector operations like gradient, divergence, and curl on different vector and scalar fields and analyze the nature of fields

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
CO's		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
	1	3	2			2					2		2	1
	2	3	2			2					2		2	1
	3	3	2										2	1
	4	3	2										2	1
	5	3	2			2							2	1
	Avg.	**3**	**2**			**2**					**2**		**2**	**1**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SIGNALS AND SYSTEMS

Contact Hours/ Week:	3(L)+2(P)	Credits:	4
Total Lecture Hours:	42(L)+28(P)	CIE Marks:	50
Sub. Code:	S3ETI01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the fundamental concepts and properties of signals and systems.
2.	Use appropriate transformations for different types of signals.
3.	Learn the basics of Sampling theorem and applications of Fourier representations.

UNIT I

Introduction and classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions.

Basic operations on discrete time signals: Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal. Expression of triangular, rectangular and other waveforms in terms of elementary signals. Discrete time system classification and properties: Linear-nonlinear, time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible-noninvertible.

10 Hours

UNIT II

Time domain representation of discrete time LTI Systems: Impulse response, convolution sum, computation of convolution sum using graphical method for two finite/infinite sequences (unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, rectangular and rectangular).

Discrete time LTI system Properties in terms of impulse response: Memory less, Causal, Stable, Invertible and Deconvolution, step response of an LTI system, and LTI system interconnection.

Difference equation representation of LTI systems: Difference equation representation and its solution by recursive method.

8 Hours

UNIT III

Fourier representations for signals: Introduction to Fourier series and Fourier transform (Qualitative analysis only).

Fourier representations for discrete time signals: Discrete time periodic signals: DFTS representation and properties of DTFS, Discrete time non- periodic signals: DTFT representation and properties of DTFT

8 Hours

UNIT IV
Applications of Fourier representations: Frequency response of discrete time LTI systems, Solution of difference equation, Fourier transform representation of discrete time periodic signals (Relating the DTFT to DTFS), Sampling of continuous time signals. Discrete Fourier Transform: Sampling of DTFT, DFT and inverse DFT.
8 Hours

UNIT V
The Z-Transforms: Z-transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction expansion and long division method, Transform analysis of LTI system, Causality and stability, Unilateral Z-transform and its application
8 Hours

TEXT BOOKS		
1	Simon Haykin and Barry Van Veen	Signals and Systems, Wiley, 2nd Edition, 2007.

REFERENCE BOOKS		
1	Alan V. Oppenheim Alan V. Willsky S. Hamid Nawab	Signals & Systems, Pearson Education India, 2nd Edition, 2015
2	Schaum's Outline Series	Signals And Systems (Special Indian Edition), TechSar Pvt. Ltd, 2nd Edition, 2013.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the basics properties of discrete time signals and systems.
CO2	Analyze the properties of discrete time signals & systems
CO3	Identify appropriate Fourier representations to analyze the signals in time and frequency domain.
CO4	Apply Fourier representations to mixed signals and sampling theorem to discretize the analog signals.
CO5	Analyze discrete time signals & systems using Z transforms.

PRACTICAL COMPONENT

1. MATLAB/Octave/Python program to generate discrete time signals
2. MATLAB/Octave/Python program to perform basic operations on the discrete time signals.
3. MATLAB/Octave/Python program to even and odd parts of discrete time signals.
4. MATLAB/Octave/Python program to find energy of discrete time signals.
5. MATLAB/Octave/ Python program to perform convolution sum and to verify the properties of convolution sum.
6. MATLAB/Octave/Python program to find the response of a LTI system.
7. MATLAB/Octave/Python program to compute the step response from the given impulse response.
8. MATLAB/Octave/Python program to solve the given difference equation.
9. MATLAB/Octave/Python program to find z-transform and inverse z-transform.
10. MATLAB/Octave/Python program to find residues and poles of z-domain signals.
11. MATLAB/Octave/Python program to find the poles and zeros of the system function H(z).
12. MATLAB/Octave/Python program to verify the important properties of z-transform.
13. MATLAB/Octave/Python program to compute and sketch the impulse response of the discrete time system governed by the given transfer function.
14. MATLAB/Octave/Python program to find DTFS/DTFT of the given discrete time signal. Also, sketch the magnitude and phase spectrum.
15. MATLAB/Octave/Python program to verify the sampling theorem

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	2	2	1	2							1	3
	2	3	2	2	1	2							1	3
	3	3	2	2	2	2							2	3
	4	3	2	2	2	2							2	3
	5	3	2	2	2	2							2	3
	Avg.	**3**	**2**	**2**	**2**	**2**							**2**	**3**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

DIGITAL ELECTRONIC CIRCUITS WITH VERILOG

Contact Hours/ Week:	3(L)+2(P)	Credits:	4
Total Lecture Hours:	42(L)+28(P)	CIE Marks:	50
Sub. Code:	S3CESI1	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Use properties of basic gates and perform simplifications of Boolean expressions using K Maps.
2.	Design Combinational & sequential circuits for given examples.
3.	Understand the functionality of various memory devices.
4.	Understand Verilog data types with operators and develop Verilog codes for digital blocks in different modelling.

UNIT I

Properties of logic gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts, Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for logic circuits using Verilog HDL program.

10 Hours

UNIT II

Combinational Logic Circuits: Binary adders and subtractors, Carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Demultiplexer, Logic design using decoders and multiplexers. Modeling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

Decoder with 7-segment display, Parallel to serial conversion using MUX.

8 Hours

UNIT III

Sequential Circuit design: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions. Registers: shift register- SISO, SIPO, PISO, Universal shift register. Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program.

8 Hours

UNIT IV
Finite state machines: Synchronous counter design, introduction to Mealy and Moore models, Mealy model: state graph and synchronous sequential circuit design, design of Sequence detector (non-overlapping), synchronous sequential circuit analysis. Develop Verilog code for sequence detector using Mealy model.
8 Hours

UNIT V
Memory Devices: Memory terminology, General memory operation, CPU–Memory Connections Read only memories: ROM Architecture, ROM timing, Applications of ROMs. Semiconductor RAM: RAM Architecture, Static RAMs, Dynamic RAMs, Read-Write cycle of RAM. Programmable logic Devices- PAL, PLA, PROM.
8 Hours

TEXT BOOKS		
1	Donald D. Givone	Digital Principles and Design, TATA Mc Graw-hill, 2017
2	Samir Palnitkar	"Verilog HDL A guide to Digital Design and Synthesis" 2nd Edition, Pearson Education ,2003

REFERENCE BOOKS		
1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, 12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st Edition 2015.
3	M Morris Mano & Michael D.Ciletti	Digital Design with an introduction to the Verilog HDL, 5th Edition, Pearson Education ,2013

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of K Maps for simplification of Boolean expressions and develop Verilog code for logic circuits.
CO2	Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.
CO3	Analyze and Implement shift registers and asynchronous counters by selecting Flip Flops and develop behavioral Verilog code.
CO4	Analyze and design synchronous sequential circuits and develop behavioral verilog code.
CO5	Analyze different memories and design logic circuits using programmable logic devices.

Digital Electronic Circuits Lab (Only for CIE) (2 Hours per week per batch) 12 Lab sessions + 1 Lab assessment List of experiments	
Part-A Hardware Experiments:	
1.	Realization of Parallel Adder/ Subtractor.
2.	Multiplexer: Adder and Subtractor using MUX.
3.	Use of Decoder chip to drive LED display.
4.	Realization of One bit magnitude comparator.
5.	Design 3-bit up-counter using T-FF.
Part-B Verilog Experiments	
1.	Develop Verilog code for full adder using (i) Dataflow description (ii) Gate-level description
2.	Develop Verilog code for 4:1 MUX using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
3.	Develop Verilog code for 2:4 decoder using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
4.	Develop Verilog code for D FF, JK FF, T FF using behavioral description.
5.	Develop Verilog code for up/down counter

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	3	1			1				2	1		2	2
	CO2	3	1			1				2	1		2	2
	CO3	3	2			1				2	1		2	2
	CO4	3	2			1				2	1		2	2
	CO5	3	2										2	
AVG.		**3**	**1.6**			**1**				**2**	**1**		**2**	**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week:	3 (L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3CES2	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Introduction of MOSFET device and design of fundamental MOSFET analog circuits
2.	Design and analysis of Differential amplifiers and concepts of Power amplifiers
3.	Discuss the concept of Opamp as a black-box and design of basic Opamp based circuits.
4.	Introduction to Linear ICs and design of 555 timer, Data converters and PLL based circuits.

UNIT I

Working Principle of MOS capacitor and MOSFET, I-V,C-V characteristics of MOSFET, Small signal models, Biasing of MOSFET amplifiers, Design of Common Source amplifier, high frequency model, Miller's Theorem, frequency response of CS amplifier.

10 Hours

UNIT II

High frequency model, Miller's Theorem, frequency response of CS amplifier. CG and CD, Cascode amplifiers, Current mirrors, amplifiers with active loads.

8 Hours

UNIT III

The MOS differential pair and their small signal operation Differential amplifiers with active load. Power amplifiers: Classification, Class A, B, AB and class C power amplifiers.

8 Hours

UNIT IV

OPAMP: Opamp as a black box, Various applications of op-amps like inverting and non-inverting amplifiers, voltage follower, Comparator, Zero-crossing detector, summing and difference amplifier, Integrators, differentiators, Instrumentation amplifier, Square wave generator, Schmitt trigger, Precision rectifier.

8 Hours

UNIT V
Linear ICs: 555 timer IC and its application Astable, Mono stable Mutivibrator, PLL 565 IC, DAC: basics, binary weighted R-DAC and R-2R DAC, ADC: DAC based ADC, Successive approximation ADC, Flash ADC
8 Hours

TEXT BOOKS		
1	Behzad Razavi	“Fundamentals of Microelectronics”, 2 nd Edition,2013,Wiely
2	Adel S. Sedra, Kenneth Carless Smith,	“Microelectronic Circuits”, Oxford University. 6th Edition. 2014
3	Sergio Franco	Design with Operational amplifiers and Analog Integrated circuits, Third Edition, Mc Graw Hill

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain the MOSFET structure, its working, small signal model
CO2	Design and analyze CS, CG, CD and Differential amplifiers
CO3	Discuss the need of Power amplifiers and design Class A, Class B power amplifiers.
CO4	Design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.
CO5	Design of circuits using Timer, PLL, ADC and DAC ICs.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO’s											**PSO’s**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO’s	**1**	3	2	1									2	2
	2	3	2	2									2	2
	3	3	2	2									2	1
	4	3	2	2									2	
	5	3	2	2									2	
	Avg.	**3**	**2**	**1.6**									**2**	**1.8**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ANALOG ELECTRONIC CIRCUITS LAB

Contact Hours/ Week:	2(P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S3ETL01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Analyze the specifications, limitations of the circuit components.
2.	Enable students to know time and frequency response of the circuits to understand its real-time applications.
3.	Relate the concepts learnt in the classroom by conducting relevant experiments by proper design and perform parametric analysis
4.	Design and parametric analysis of CE amplifier, Opamp amplifiers, Opamp based circuits
5.	Design and parametric analysis of Timer based circuits

Sl. No.	List of the Experiments
1.	Diode applications: Design and demonstration of Rectifier and voltage regulator (+5, ± 12V, 3.3 V), Wave shaping circuits (Clipping, Clamping circuits)
2.	BJT Amplifiers- CE amplifier, CC amplifiers
3.	Op-amp applications: Inverting, Non- inverting amplifier, Schmitt trigger, square wave generator
4.	555 Timer Applications: A stable, Mono stable, Bi-stable Multi vibrators
5.	3 and 4 bit Binary weighted and R-2R DAC determine INL, DNL
6.	Successive approximation type ADC circuits IC 0808 555 Timer applications of Astable and Mono stable Multi vibrators
7.	3 and 4 bit Binary weighted and R-2R DAC determine INL, DNL

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	Design and demonstration of power supply, BJT amplifiers
CO2	Design and demonstration Op amp based circuits and timer circuits.
CO3	Design and demonstration ADC and DAC circuits
CO4	Design and demonstration DC Power supply
CO5	Design and analysis of Wave shaping circuits

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**			2	1	2				2			1	
	2			2	2	2				2			2	
	3			2	2	2				2			2	
	4													
	5													
	Avg.			2	1.67	2				2			1.67	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ENGINEERING SCIENCE COURSE
NUMERICAL METHODS IN ENGINEERING

Contact Hours/ Week:	3 (L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3ETESC02	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the importance of error analysis in Engineering problems and to solve an application problem using a system of linear equations.
2.	Analyze regression data to choose the most appropriate model for a situation.
3.	Solve mathematical models represented by initial or boundary value problems.

UNIT I

Errors in computations and Root of the equations

Approximations and Round Off -Errors in computation: Error definitions, Round-Offerrors, Truncation errors and the Taylor series-The Taylor series, Error Propagation, Total numerical error, Absolute, Relative and percentage errors, Blunders, Formulation errors and data uncertainty. Roots of equations: Simple fixed point iteration methods. Secant Method, Muller’s method, and Graeffe’s Roots Squaring Method. Aitkin’s Method.

10 Hours

UNIT II

Solution of System of Linear Equations

Rank of the matrix, Echelon form, Linearly dependent and independent equations, Solutions for linear equations, Partition method, Croute's Triangularisation method. Relaxation method. Solution of non-linear simultaneous equations by Newton-Raphson method. Eigen Values and properties, Eigen Vectors, Bounds on Eigen Values, Jacobi’s method, Given’s method for symmetric matrices.

8 Hours

UNIT III

Curve Fitting Least-Squares Regression: Linear Regressions, Polynomial regressions, Multiple Linear regressions, General Linear Least squares, Nonlinear Regressions, QR Factorization. Curve Fitting with Sinusoidal Functions

Introduction to Splines, Linear Splines, Quadratic Splines, Cubic Splines. Bilinear Interpolation.

8 Hours

UNIT IV
Numerical integration, Difference equations and Boundary Value Problems Romberg’s method, Euler-Maclaurin formula, Gaussian integration for n = 2 and n=3. Numerical double integration by trapezoidal and Simpson’s 1/3 rd rule. Solution of linear difference equations. Boundary-Value Problems, Introduction. The Shooting Method, Finite-Difference Methods
8 Hours

UNIT V
Numerical solution of partial differential equations Classifications of second-order partial differential equations, Finite difference approximations to partial derivatives. Solution of: Laplace equation, Poisson equations, one-dimensional heat equation and wave equations.
8 Hours

TEXT BOOKS		
1	Steven C. Chapra and Raymond P. Canale	Numerical Methods for Engineers, McGraw Hill Education India Private Limited, 7th Edition, 2016.

REFERENCE BOOKS		
1	R. J. Shilling and S.L. Harries	Applied Numerical methods for Engineers using MATLAB and C, Cengage Learning, 1st Edition, 2006.
2	K. Sankara Rao	Numerical methods for Scientists and Engineers, PHI Learning, 4th Edition, 2018

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Describe the basic concepts of error analysis in computational schemes.
CO2	Apply numerical methods to find solution of algebraic equations using different methods under different conditions.
CO3	Apply various interpolation methods and finite difference concepts.
CO4	Apply numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO5	Use appropriate numerical methods to study phenomena modelled as partial differential equations.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

CO's		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
	1	3	2	2									2	
	2	3	2	2									2	
	3	3	2	2									2	
	4	3	2	2									2	
	5	3	2	2									2	
	Avg.	**3**	**2**	**2**									**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SENSORS AND INSTRUMENTATION

Contact Hours/ Week:	3 (L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3ETESC03	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Impart the principles working mechanism of various sensors and devices that are in use to measure the important physical variables of various systems.
2.	Discuss need of sensors, their classification, advantages and disadvantages
3.	Explain recent trends in sensor technology and their selection
4.	Explain importance and requirement of calibration, references, and measurement methods of different types of measuring instruments

UNIT I

Introduction to sensor based measurement systems: General concepts and terminology, sensor classification, Primary Sensors, material for sensors, microsensor technology.

10 Hours

UNIT II

Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors.

8 Hours

UNIT III
Principles of Measurement: Static Characteristics, Error in Measurement, Types of Static Error. Multi-range Ammeters, Multi-range voltmeter. Digital Voltmeter: Ramp Technique, Dual slope integrating Type DVM, Direct Compensation type and Successive Approximations type DVM.
8 Hours

UNIT IV
Digital Multimeter: Digital Frequency Meter and Digital Measurement of Time, Function Generator. Bridges: Measurement of resistance: Wheatstone's bridge, AC Bridges - Capacitance and Inductance Comparison bridge, Wien's bridge. @#12102023 @#12102023
8 Hours

UNIT V
Transducers: Introduction, Electrical Transducer, Resistive Transducer, Resistive position Transducer, Resistance Wire Strain Gauges, Resistance Thermometer, Thermistor, LVDT. Instrumentation Amplifier using Transducer Bridge, Temperature indicators using Thermometer, Analog Weight Scale.
8 Hours

TEXT BOOKS		
1	Ramon Pallas Areny, JohnG. Webster	"Sensors and Signal Conditioning", 2 nd edition, John Wiley and Sons, 2000
2	H.S.Kalsi,	Electronic Instrumentation, Mc Graw Hill, 3rd Edition, 2012, ISBN: 9780070702066.
REFERENCE BOOKS		
1	David A. Bell	Electronic Instrumentation & Measurements", Oxford University Press PHI 2nd Edition, 2006, ISBN 81-203-2360-2.
2	D. Helfrickand W.D. Cooper	"Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1stEdition, 2015, ISBN: 9789332556065

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Demonstrate the concept of transduction and methods of extracting data from sensors
CO2	Analyze sensor outputs and design signal conditioning circuits based on applications
CO3	Analyze static characteristics and errors in voltage and current measuring instruments
CO4	Analyze and use the circuit for the measurement of R, L, C, I, V and Demonstrate the use of CRO, Ammeters, Voltmeter and Mustimeters
CO5	Discuss the need of important concepts such as calibration and references of different types of measuring instruments

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	3	2									2	1
	2	2	2	3									2	1
	3	3	3	1									2	1
	4	3	3	1									2	1
	5	3	2	1									2	1
	Avg.	**3**	**2**	**1**									**2**	**1**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

OPERATING SYSTEMS

Contact Hours/ Week:	3 (L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3ETESC04	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the services provided by an operating system
2.	Explain how processes are synchronized and scheduled
3.	Understand the different approaches of memory management and virtual memory management
4.	Describe the structure and organisation of the file system.
5.	Understand inter process communication and dead lock situations.

UNIT I

Introduction to Operating System: OS, goals of an OS, Computational structures, resource allocation techniques, efficiency, system performance and user convenience, classes operating system, batch processing, multiprogramming, time sharing system, real time and distributed operating systems

10 Hours

UNIT II

Process Management: OS view of processes, PCB, Fundamental state, Transitions of a process, Threads, Kernel and User level Threads, Non-Preemptive Scheduling-FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling Linux.

8 Hours

UNIT III

Memory Management: Contiguous Memory Allocation, Non-contiguous Memory Allocation, Paging, Segmentation with Paging, Virtual Memory Management, Demand Paging, VM Handler, FIFO, LRU Page replacement policies, Virtual memory in Unix and Linux.

8 Hours

UNIT IV

File systems: File systems and IOCS, File Operation, File Organization, Directory Structure, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access

8 Hours

UNIT V
Message passing and deadlocks: Overview of Message Passing, implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlocks detection algorithm, Deadlocks Prevention.
8 Hours

TEXT BOOKS		
1	Dhamdhere,	Operating system - A concept-based Approach, TMH, 2nd edition.

REFERENCE Web links and Video Lectures (e-Resources):	
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs72/preview
4	https://nptel.ac.in/courses/106106144
5	https://nptel.ac.in/courses/106102132
6	https://nptel.ac.in/courses/106106168
7	https://archive.nptel.ac.in/courses/106/102/106102132/

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain the goals, structure, operation and types of operating system
CO2	Apply scheduling techniques to find performance factors
CO3	Explain organization of file system and IOCS.
CO4	Apply suitable techniques for contiguous and non-contiguous memory allocation.
CO5	Describe message passing, deadlock detection and prevention methods.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	2	1										
	2	2	3	2										
	3	2	3	2										
	4	1	2	3										
	5	1	3	3										
	Avg.	**1.8**	**3**	**2.2**										

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

DATA STRUCTURES USING C

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3ETESC05	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the basic concepts of C programming and the fundamental principles of data structures
2.	Describe and implement linear data structures like arrays, stacks, and queues, and apply them to solve real-world problems.
3.	Describe and implement the concept of linked lists, their types, operations, and how they are used in dynamic memory management and complex data representations.
4.	Design and implement trees and their applications.
5.	Understand the basic concepts of C programming and the fundamental principles of data structures

UNIT I

Introduction to Data Structures and C Programming:
Basics of C programming: Structure of C program, constants, Variables, Data types, Operators and expressions, Control statements, Functions, Arrays, strings, Pointers.
Introduction to Data Structures: Introduction, Algorithms, Types of Data structures, Data structure operations.

10 Hours

UNIT II

Stacks and Recursion:
Stacks: Introduction, Stack operations (Push, Pop), Stack implementation (array implementation, Linked implementation), Coding examples.
Recursion: Introduction, Recurrence relation, Types of recursion, Coding examples.

8 Hours

UNIT III

Queues: Introduction, Queues- basic concept, Queue operations, Queue implementation, Types of Queues (Simple Queue, Circular Queue, Priority Queue, Double-ended Queue), Coding examples.

8 Hours

UNIT IV
Linked Lists: Introduction, Linked lists- Basic concepts, Linked list implementation, Types of Linked list, Circular Linked List (Operations and Implementation), Doubly Linked List(Operations and Implementation), Coding examples.. Applications of Linked Lists: Polynomial representation, Sparse matrices.
8 Hours

UNIT V
Trees: Basic Tree Concepts: Introduction, Terminology, Binary Trees, Representation of Binary Tree, Binary tree traversal, Binary Search Trees (BST), Tree variants, Coding examples. **Balanced Trees:** Introduction to AVL Trees, Generating AVL tree, Inserting AVL with rotations, Deletions from AVL Tree with rotations, Coding examples.
8 Hours

TEXT BOOKS		
1	E.Balagurusamy	Programming in ANSI C, 7^{th} Edn., Tata McGraw-Hill Publications, 2017. (Unit I)

REFERENCE BOOKS		
1	Horowitz, Sahni and Anderson-Freed	Fundamentals of Data Structures in C, 2^{nd} Edn., Universities Press Pvt. Ltd., 2011
2	Horowitz, Sahni and Anderson-Freed	Fundamentals of Data Structures in C, 2^{nd} Edn., Universities Press Pvt. Ltd., 2011
3	Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum	Data structures using C and C++, PHI/Pearson, Edition 2, 2015. (Unit II to V)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Demonstrate a strong foundation in C programming and fundamental data structures
CO2	Implement of stacks to solve programming problems and understand their applications in real-time systems.
CO3	Implement of queues to solve programming problems and understand their applications in real-time systems.
CO4	Apply linked list data structures to solve problems, such as polynomial arithmetic and sparse matrix representation, and implement all standard operations.
CO5	Design and implement non-linear data structures such as trees, particularly BSTs, while also learning about tree traversal techniques.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO's	1	2	2			1							1	
	2	2	2	2		1							1	
	3	2	2	2		1							2	
	4	3	3	3		1							2	
	5	3	3	3		1							2	
	Avg.	**2.4**	**2.4**	**2.4**		**1**							**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SOCIAL CONNECT & RESPONSIBILITIES

Contact Hours/ Week:	0+0+2	Credits:	1
Total Lecture Hours:	26	CIE Marks:	50
Sub. Code:	SHS01	SEE Marks:	-

Course objectives:

This course will enable students to:

1.	Do a deep drive into societal challenges being addressed by NGO(s), social enterprises & The government and build solutions to alleviate these complex social problems through immersion, design & technology.
2.	Provide a formal platform for students to communicate and connect with their surroundings.
3.	Enable to create of a responsible connection with society.

Contents:

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large. The course will engage students in interactive sessions, open mic, reading groups, storytelling sessions, and semester-long activities conducted by faculty mentors. In the following a set of activities planned for the course have been listed:

UNIT I

Plantation and adoption of a tree: Plantation of a tree by Miyawaki Method that will be adopted by entire semester by a group of students. They will also make an excerpt either as a documentary or a photoblog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

6 Hours

UNIT II
Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms.
6 Hours

UNIT III
Organic farming: Definition of organic farming, Organically grown crops in India, Differentiate between conventional farming and organic farming, Necessity of organic farming, Key characteristics of organic farming, Four principles of organic farming(principle of Health, principle of ecology, principle of fairness and principle of care),Types of organic farming: 1) Pure organic farming, 2) Integrated farming (Integrated nutrient management and Integrated pest management), objectives of organic farming, benefits of organic farming, Basic steps in organic farming and limitations of organic farming.
4 Hours

UNIT IV
Water Conservation: Global Water Scarcity - Global water crisis and its implications; Rainwater Harvesting - Concept and benefits of rainwater harvesting; Water Audit – An approach to water conservation; Efficient Water Use - Optimizing water consumption in daily life .
6 Hours

UNIT V
Food Walk City’s culinary practices, food lore, and indigenous materials of the region used in cooking.
4 Hours

Activities:

1. **Plantation and adoption of a tree:** Select suitable species in consultation with horticulture, forest or agriculture department. Interact with NGO/Industry and community to plant Tag the plant for continuous monitoring
2. **Heritage walk and crafts corner:** Survey in the form of questioner by connecting to the people and asking. Questions during survey can be asked in local language but report language is English.
3. **Organic farming:** Collect data on organic farming in the vicinity. Like types of crop, methodology etc.,
4. **Water Conservation:** Report on traditional water conservation practices (to minimize wastage)

5. **Food Walk**: Survey local food centres and identify its specialty, Identify and study the food ingredients, Report on the regional foods, Report on Medicinals values of the local food grains, and plants.

PEDAGOGY

The pedagogy will include interactive lectures, inspiring talks by various departments, field visits, social immersion. Applying and synthesizing information from these sources to define the social problem with your group. Social immersion with NGOs/social sections will be a key part of the course.

Guidelines for Assessment Process:

Continuous Internal Evaluation (CIE)

- Student shall keep a separate dairy and prepare report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period.
- Report shall be handwritten or blog with paintings, sketches, poster, video and/or photograph with Geo tag.
- The report should be signed by the mentor.
- The report shall be evaluated on the basis of the following criteria (see Table below) and/or other relevant criteria pertaining to the activity completed.
- Each module is evaluated for 35 Marks and final presentation will be for 15 marks.

Sl. No.	Particulars (for each module)	Maximum Marks
1	Planning and scheduling the social connect	10
2	Information/Da ta collected during the social connect	10
3	Report writing	15
4	Final Presentation from the group	15
	Total	50

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Develop social responsibility
CO2	Practice sustainability and creativity
CO3	Showcase planning and organizational skills

ABILITY/ SKILL ENHANCEMENT COURSES

ARDUINO / RASPBERRY PI BASED MICRO PROJECTS

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S3ETA01	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Develop skills (on operating principle, rating, pin description, data sheets, etc) on different types of sensors required in various smart systems
2.	Provide basic information on the requirements of signal conditioning circuits (generating the required voltage and current levels for Arduino and actuators) and their design for seniors and Arduino projects.
3.	How to use and program Arduino Uno in various smart system applications
4.	Demonstrate the integration of sensors with Arduino Uno for different applications

Experiment List :Demonstration of Prototype Devices	
1.	Water level detection and turn ON or OFF of motor based on water level using ultrasonic sensor and Arduino Uno.
2.	Turn the bulb ON or OFF based on night or day respectively using relay, LDR and Arduino Uno.
3.	Count the number of persons enter the hall and close the door (servo motor can be used) if the number exceeds 50 using PIR sensor.
4.	Open and close the door (servo motor can be used) automatically to enter and leave the hall and provide the count of number persons entered and left, and do not open the door if number of persons inside the room is 50 using IR sensor and Arduino Uno.
5.	Turn on the fan and control the speed of fan (dc motor) based on temperature using temperature sensor LM35. At least three levels of speed.
6.	Read the temperature using temperature sensor and display the value on two digit seven segment display.
7.	Implement counter to count from 00 to 60 using seven segment display.

8.	Vary output voltage of potentiometer and display it on LCD display.
9.	Display alphabets (A-Z) and numbers (0-9) on dot matrix, use scanning method to display.
10.	Write the program to read the temperature from LM35 and scroll the temperature value on LCD display.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Choose sensor based on application and conduct experiment to study the performance of the sensor.
CO2	Analyze the requirement of given smart system, choose sensors, design basic signal conditioning circuits (generate required voltage and current levels for Arduino and actuators) and demonstrate through experiment.
CO3	Develop Arduino Uno code to perform different tasks, analyze and debug errors in code
CO4	Integrate sensors with Arduino Uno and develop smart systems.
CO5	Work in team and Carryout inter disciplinary projects.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	2	1		1							2	1
	2	2	3	2		2							2	1
	3	2	3	2		3							2	1
	4	1	2	3		3							2	1
	5	1	3	3		3				2			2	1
	Avg.	**1.8**	**3**	**3**		**3**				**2**			**2**	**1**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

LabVIEW SIMULATIONS

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S3ETA02	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Get aware of various front panel controls and indicators.
2.	Connect and manipulate nodes and wires in the block diagram.
3.	Locate various tool bars and pull-down menus for the purpose of implementing specific functions.
4.	Understand different applications of LabVIEW programming.
5.	Get aware of various front panel controls and indicators.

Sl. No.	**VI Programs (using LabVIEW software)to realize the following:**
1	Basic arithmetic operations: addition, subtraction, multiplication and division
2	Boolean operations: AND, OR, XOR, NOT and NAND
3	Sum of ‘n’ numbers using ‘for’ loop
4	Factorial of a given number using ‘for’ loop
5	Determine square of a given number
6	Factorial of a given number using ‘while‘ loop
7	Sorting even numbers using ‘while’ loop in an array
8	Finding the array maximum and array minimum

Demonstration Experiments

9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).
11	Build a Virtual Instrument that simulates a Water Level Detector.
12	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Perform various mathematical operations using LabVIEW.
CO2	Perform various logical operations using LabVIEW.
CO3	Create user interfaces with charts, graph and buttons.
CO4	Program using structures and data types that exist in LabVIEW.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2				2								2
	2	2				2								2
	3	2				2								2
	4	2				2								2
	5	2				2								2
	Avg.	**2**				**2**								**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

EMBEDDED C BASICS PROGRAMMING

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S3ETA03	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Understand the basic programming of Microprocessor and microcontroller.
2.	Develop the microcontroller-based programs for various application in simulation environment
3.	Program a microcontroller to control an external hardware using suitable I/O ports.

Sl. No	Experiments
1	Write a 8051C program to multiply two 16 bit binary numbers.
2	Write a 8051 C program to find the sum of first 10 integer numbers.
3	Write a 8051 C program to find factorial of a given number.
4	Write a 8051 C program to add an array of 16bit numbers and store the 32 bit result in internal RAM
5	Write a 8051C program to find the square of a number (1to10)using look-up table.
6	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7	Writea8051 C program to arrange a series of 32bit numbers in ascending/descending order
8	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
9	Write a 8051C program to scan a series of 32bit numbers to find how many are negative.
10	Writea8051 C program to display “HelloWorld” message (either in simulation mode or interface an LCD display).
11	Write a 8051C program to generate the waveforms: square, triangle and ramp, using DAQ.
12	Write a 8051 C program to run a stepper motor in clock wise and counter clockwise direction with a given step angle.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Write C programs in 8051for solving simple problems that manipulate input data using different instructions.
CO2	Develop testing and experimental procedures on 8051Microcontroller, analyze their operation under different cases.
CO3	Develop programs for 8051Microcontroller to implement real world problems
CO4	Develop microcontroller applications using external hardware interface.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2										1	
	2		2	2									2	
	3		2	2									2	
	4	2	2										2	
	Avg.	**2**	**2**	**2**									**1.75**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

SIGNAL PROCESSING LAB

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S3ETA04	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Prepare students with fundamental knowledge /overview in the field of Signal Processing
2.	Familiarize with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications.
3.	Equip students with a basic foundation of Signal Processing by delivering the basics of quantitative parameters for Matrices & Linear Transformations, the mathematical description of discrete time signals and systems, analyzing the signals in time domain using convolution sum, classifying signals into different categories based on their properties

Sl. No	Experiments executed using programming languages Scilab / MATLAB
1	a. Program to create and modify a vector (array). b. Program to create and modify a matrix.
2	Programs on basic operations on matrix.
3	Program to solve system of linear equations.
4	Program for Gram-Schmidt orthogonalization.
5	Program to find Eigen value and Eigen vector.
6	Program to find Singular value decomposition.
7	Program to generate discrete waveforms.
8	Program to perform Basic operation on signals.
9	Program to perform convolution of two given sequences.
10	a. Program to perform verification of commutative property of convolution. b. Program to perform verification of distributive property of convolution. c. Program to perform verification of associative property of convolution.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	At the end of the course, the student will be able to:
CO2	Understand the basics of Linear Algebra
CO3	Analyze different types of signals and systems
CO4	Analyze the properties of discrete-time signals & systems
CO5	Analyse discrete time signals & systems using Z transforms

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	3	2		1								2
	2	3	3	3		2								2
	3	3	3	3		2								2
	4	3	3	3		2								2
	5													
	Avg.	**2.75**	**3**	**2.75**		**1.75**								**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

PRINCIPLES OF COMMUNICATION SYSTEMS

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4ET01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the fundamentals of analog communication system both time and frequency domain.
2.	Understand the effect of Additive white Gaussian noise in different receivers.
3.	Know the conversion of analog signals to digital data and represent the digital data in digital formats.
4.	Understand pulse shaping techniques to reduce inter symbol interference.

UNIT I

Amplitude Modulation: Conventional Amplitude Modulation, Double- Sideband Suppressed Carrier, Single-Sideband, Vestigial-Sideband, Implementation of AM Modulators and Demodulator: Power-Law Modulation, Switching Modulator, Balanced modulator, ring modulator, Envelop detector, Demodulation of DSB-SC AM Signal, Signal Multiplexing.

10 Hours

UNIT II

Angle Modulation: Representation of FM and PM Signals, narrowband angle modulation, Spectral Characteristics of Angle-Modulated Signals, Angle modulation by sinusoidal signal, Implementation of Angle Modulators and Demodulators, Radio Broadcasting: AM/FM Radio Broadcasting

8 Hours

UNIT III

Noise: Introduction, Shot noise, Thermal noise, White noise, Noise equivalent bandwidth, Narrowband noise, Noise figure, Equivalent noise temperature, Cascade connection of two-port networks.
Noise in Receivers: Introduction, Receiver model, Noise in DSB-SC receivers, Noise in AM receivers and Noise in FM receivers, FM threshold effect.

8 Hours

UNIT IV
Introduction to digital communication: Baseband Systems, The Sampling Theorem, Aliasing, Signal Interface for a Digital System, Sources of Corruption, Sampling and Quantizing Effects, Channel Effects, Signal-to- Noise Ratio for Quantized Pulses, Pulse Code Modulation, Uniform and Non-uniform Quantization Statistics of Speech Amplitudes, Non-uniform Quantization, Companding Characteristics, Baseband Modulation, Waveform Representation of Binary Digits, PCM Waveform Types, Spectral Attributes of PCM Waveforms, Bits per PCM Word and Bits per Symbol, M-ary pulse modulation waveforms
8 Hours
UNIT V
Baseband demodulation/detection: Signals and Noise, Error-Performance Degradation in Communication Systems, Demodulation and Detection, Vectorial View of Signals and Noise, The Basic SNR Parameter for Digital Communication Systems, Detection of Binary Signals in Gaussian Noise, Maximum Likelihood Receiver Structure, Inter-symbol Interference, Pulse Shaping to Reduce ISI.
8 Hours

TEXT BOOKS		
1	John G Proakis Masoud Salehi	Communication Systems Engineering, 2nd Edition, 2015
2	Bernard Sklar	Digital Communications - Fundamentals and Applications", 2nd Edition Pearson Education (Asia) Ptv. Ltd, 2021.

REFERENCE BOOKS		
1	Simon Haykin	An introduction to Analog and Digital communications, 2006, Wiley India.
2	Lathi B.P. Modern	Digital and Analog communication systems. Ed 3. Oxford
3	John G. Proakis	Digital Communications, 4th edition, McGraw Hill, 2001
4	Simon Haykin	Digital Communications, John Wiley and Sons, 2013

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply engineering fundamentals and analyze mathematical model, block diagram, circuit diagram of various amplitude modulation and demodulation techniques and infer their performance parameters like power and bandwidth.
CO2	Elucidate the functional block diagram of Angle modulation & demodulation and their modelling.
CO3	Compare and infer the effect of noise in receivers of analog communication systems.
CO4	Analyze different sampling techniques and quantization mechanisms.
CO5	Analyze PCM technique for data transmission and compare different pulse shaping schemes to reduce ISI.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO's	1	2	2											2
	2	1	2											2
	3	1	2											2
	4	2	2											2
	5	2	2											2
	Avg.	2	2											2

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

CONTROL SYSTEMS

Contact Hours/ Week:	3(L)+2(P)	Credits:	4
Total Lecture Hours:	42(L)+28(P)	CIE Marks:	50
Sub. Code:	S4CESI01	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Understand concepts of the mathematical modeling, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Block diagrams reduction techniques and signal flow graphs applicable to electrical network.
2.	Study Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
3.	Understand Feedback control and stability analysis in Time and Frequency domains: Definition, Routh-Hurwitz criterion and Root locus techniques
4.	Analyse the Stability in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
5.	Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance. State Space Analysis: State models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems.

UNIT I
Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems–mechanical systems, Electrical systems. ● Translational and rotational systems ● Transfer function of Electrical networks, Relevant examples signal flow graphs: signal Flow graph, Mason's gain formula applicable to electrical systems.
10 Hours

UNIT II
Time Response Analysis: UNIT step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis. Feedback Controllers: Design of feedback controllers based on time response applicable to electrical systems. Relevant examples
8 Hours

UNIT III
Concept of Stability: Frequency Response Analysis: Routh-Hurwitz Criteria, Relative Stability analysis. Root–Locus Techniques: The root locus concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications to electrical systems. Relevant examples and applications
8 Hours

UNIT IV
Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response(Transfer function) from Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin, Stability analysis in Electrical systems. Relevant examples and applications
8 Hours

UNIT V
System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to electrical systems. Suitable examples and applications. State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, solution of state equation, state transition matrix
8 Hours

TEXT BOOKS		
1	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Ed 13, Pearson Education, 2013, ISBN-10 : 0134407628 ISBN-13 : 978-0134407623
2	Nagrath and Gopal M.	Control Systems Engineering. Ed 4, New Age International (P) Limited. 2005. ISBN 10: 8122422845ISBN 13: 9788122422849.

REFERENCE BOOKS		
1	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
2	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9th edition, 2014 Language: English, ISBN 10: 9788126552337 ISBN-13: 978-8126552337

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Formulate the mathematical model for linear-time-invariant systems and obtain the transfer functions using block diagram reduction technique and signal flow graphs.
CO2	Analyze transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. Design and analyze the performance of feedback controllers to improve the stability of linear-time-invariant systems.
CO3	Analyze and interpret the stability of linear-time invariant systems by applying RH criteria and root locus techniques.
CO4	Analyze and interpret the stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.
CO5	Design of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and develop the state models for the linear-time-invariant systems.
Lab Components	
1.	Verification of transfer function of Electrical and Electronic circuits.
2.	Realization of Desired Transfer function using electrical circuits.
3.	Verification voltage Amplifier transfer function
4.	Verification of stability of amplifiers and condition for oscillations
5.	Realization of RC and LC oscillators
6.	I and II order RC filters

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2			2							1	
	2	2	2										2	
	3		3	2		2							2	
	4		3	2		2							2	
	5		3	2		2							2	
	Avg.	**2**	**2.6**	**2**		**2**							**1.8**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ARM MICROCONTROLLER

Contact Hours/ Week:	3(L)+2(P)	Credits:	4
Total Lecture Hours:	42(L)+28(P)	CIE Marks:	50
Sub. Code:	S4CESI02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Provide basic understanding of ARM processor and peripherals.
2.	Provide efficient solutions to real life problems using ARM architecture.
3.	Provide a holistic view of ARM architecture, cache, MMUs

UNIT I

ARM Embedded Systems: Harvard and Von-Neumann Architecture, CISC vs RISC, RISC design philosophy, ARM design philosophy, embedded system hardware, embedded system software., ARM7TDMI processor core diagram.

10 Hours

UNIT II

ARM Processor Fundamentals: ARM Data flow Model, Processor Operating States, Memory formats: Big endian and Little endian formats, Data types, Operating Modes, Registers – ARM state register set and Thumb state register set, the relationship between ARM state and Thumb state registers, Program Status Registers, Exceptions, Interrupt latencies, Reset, Pipeline.

8 Hours

UNIT III
LPC214X ARM-based microcontroller: Features of LPC214x Microcontroller, LPC 214x block diagram, Memory Maps. Register description and C- programming of GPIO; ADC. Interfacing LED, Switch, Push button keys to LPC214x microcontroller.
8 Hours

UNIT IV
Caches: The Memory Hierarchy and Cache Memory, Cache Architecture Cache Policy, concepts of Flushing and Cleaning Cache Memory, concepts of Cache Lockdown. **Memory Protection Units**: Protected Regions, concept of access permission.
8 Hours

UNIT V
Memory Management Units: How Virtual Memory Works, Details of the ARM MMU, Page Tables, The Translation Lookaside Buffer, Domains and Memory Access Permission, The Caches and Write Buffer.
8 Hours

TEXT BOOKS

1	Andrew N. Sloss, Dominic Symes and Chris Wright	ARM System Developer's Guide – Designing and Optimizing System Software, Elsevier 2004.

REFERENCE BOOKS

1	Shibhu K.V	Introduction to Embedded Systems, 2nd Edition TMH, 2017.
2	ARM7TDMI	Datasheet
3	UM10139 LPC214x User manual	

Integrated Lab Using Embedded C and/ or LPC 2148

List of Experiments:

1. Programs for addition/ subtraction/ multiplication of numbers
2. Programs for sorting of Numbers
3. Develop a program for Flashing LED
4. Develop a program to generate square wave / sine wave/ triangular wave using GPIO
5. Develop a program to turn on LED whenever a push button is pressed and sound the alarm
6. Develop a program to convert given analog voltage to digital value
7. Develop a program to generate a square wave on a GPIO pin when a key is pressed and stop whenever key is released

8. Develop a program to interface a DC motor and rotate it in clockwise and anticlockwise direction.
9. Develop a program to interface LCD unit and display a message.
10. Develop a program to generate square wave / sine wave/ triangular/Staircase wave using DAC of LPC2148
11. Develop a program to display the key pressed from keypad over a 16X2 LCD using LPC2148

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Identify and analyze typical hardware and software technologies that surround an ARM controller.
CO2	Analyse the programmer's model of the ARM controller.
CO3	Analyse the functionalities and Design software solutions using ADC, GPIO for ARM based Microcontroller-LPC 214x
CO4	Illustrate things a cache memory can do to make programs on ARM controller run faster.
CO5	Analyze functionality of ARM memory management units and Memory Protection Units
CO6	Demonstrate the ability to provide efficient solutions for complex engineering problems using Embedded C in the area of ARM controllers individually and working in a team (CO for laboratory)

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2										1	
	2	2	1	1									1	
	3	2	2	2									2	
	4	3	2	2									2	
	5	2	2										2	
	Avg.	**2.2**	**1.8**	**1.67**									**1.6**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

COMMUNICATION SYSTEMS LAB

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S4ETL01	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Demonstrate Analog communication systems using various analog modulation/demodulation schemes in LabVIEW
2.	Demonstrate the Frequency Division Multiplexing in LabVIEW.
3.	Demonstrate the Super heterodyne Receiver in LabVIEW
4.	Understand, realize and verify the sampling theorem and line codes for digital transmission using LabVIEW programming.

Simulation experiments using LabVIEW	
1.	Develop a LabVIEW code for realizing Standard Amplitude Modulation and demonstrate the effects of modulation index, frequency of message and carrier, amplitude of message and carrier on modulated signal.
2.	Develop a LabVIEW code Demodulation of Amplitude Modulated Wave (using envelop detector), demonstrate the effects of modulation index, frequency of message and carrier, amplitude of message and carrier.
3.	Develop a LabVIEW code for realizing Double sideband suppressed carrier (DSBSC) Modulation and Demodulation, Demonstrate the effects of modulation index, frequency of message and carrier, amplitude of message, and carrier on modulated signal.
4.	Develop a LabVIEW code for realizing Frequency Modulation and demonstrate the effects of frequency deviation on modulated signal.
5.	Develop a LabVIEW code Demodulation of Frequency Modulated Wave
6.	Develop a LabVIEW code for demonstrating the working principle of Frequency Division Multiplexing
7.	Develop a LabVIEW code for realization of Super Heterodyne Receiver
8.	Develop a LabVIEW code for realization of Single Side Band modulation
9.	Develop a LabVIEW code to demonstrate the Sampling Theorem

10.	Develop a LabVIEW code for to realize the various Line codes for digital data transmission i. NRZ Unipolar ii. RZ Unipolar iii. Bipolar NRZ iv. Bipolar RZ v. Manchester code.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Design, Develop and Demonstrate Analog communication systems using various analog modulation/demodulation schemes in LabVIEW
CO2	Design, Develop and demonstrate the Frequency Division Multiplexing in LabVIEW.
CO3	Design, Develop and demonstrate the Super heterodyne Receiver in LabVIEW
CO4	Realize and verify the sampling theorem and line codes for digital transmission using LabVIEW programming

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	2	2			2								2
	2	2	2			2								2
	3	2	2			2								2
	4	2	2			2								2
	Avg.	**2**	**2**			**2**								**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ENGINEERING SCIENCE COURSES

FIELDS, WAVES AND TRANSMISSION LINES

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4ETESC01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the time varying field through Maxwell’s equations.
2.	Understand the Electromagnetic waves traveling through free space, lossy dielectric, lossless dielectric and conductors
3.	Understand Maxwell’s equations for various incidence of plane waves.
4.	Identify and solve engineering problems related to transmission lines at audio, RF and Microwave frequencies.
5.	Address the complexities of real transmission line problems and be able to analyse, design and formulate solutions related to design of various RF and microwave devices

UNIT I

Time varying fields and Maxwell's equations:

Faraday's law, displacement current, Maxwell's equation in point and integral form. Time harmonic fields, Time harmonic Maxwell’s equations. Electromagnetic waves: Uniform plane wave, Wave propagation in free space and dielectrics, Propagation in good conductors (skin effect).

10 Hours

UNIT II

Electromagnetic Wave Propagation: Poynting vector and power considerations. Reflection of plane wave at normal Incidence, Reflection of a plane wave at oblique incidence: Parallel polarization. Applications: Microwaves for communication, radar systems and heating.

8 Hours

UNIT III

Transmission Line Theory: The lumped element circuit model for a transmission line-cascaded T sections, Transmission line equations and general solution, Physical interpretation of the solutions, Infinite line. Distortions in the line, the distortion less line, Reflection on a line not terminated in Z0, Reflection coefficient, input impedance, Open and short circuited lines. Dissipation less or Lossless Lines: Line constants for lossless lines, Voltages and currents on lossless lines, Standing waves, Standing wave ratio, Input impedance of a lossless line; input impedance of open and short circuited lines, Reflection loss on an unmatched line.

8 Hours

UNIT IV
Smith chart- Introduction, the normalized impedance and- Admittance (ZY) smith chart. Applications of smith chart: Measurement of K, VSWR, Input impedance, unknown impedance using smith chart, Input impedance of open and short circuited lines, design of transmission line inductor and capacitors, Input impedance determination using lumped elements and single stubs
8 Hours
UNIT V
Planar Transmission lines and Waveguides: Stripline, Formula for Propagation Constant, Characteristic Impedance, and Attenuation, Micro-strip line, wave propagation in micro-strip Lines, Empirical formulas for effective dielectric constant, characteristic impedance, wavelength and attenuation factors, Waveguides: Rectangular waveguide-TE and TM modes, Dominant TE mode and its characteristics, Wave impedances(No derivations are Involved).
8 Hours

TEXT BOOKS		
1	Matthew N O Sadiku	Elements of electromagnetics. 7 Edition, Oxford Univ. Press. 2018.
2	Matthew. M. Radmanesh	“RF and microwave electronics illustrated”, Pearson India Edition, 2015
3	D M Pozar	Microwave Engineering, 4 Edition, Wiley Student Edition., 2014

REFERENCE BOOKS		
1	Joseph Edminster and Nahvi, Mahmood	Electromagnetics-McGraw-Hill Education (Schaum’s Outlines,) 5 Edition 2019
2	William H Jr. Hayt and John A Buck	Engineering Electromagnetics. 7 Edition. Tata McGraw-Hill. 2006.
3	John D. Ryder	Networks, Lines and Fields, PHI, 2003

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply the basics of Maxwell's equations for static fields to time varying fields and outline the characteristics of uniform plane wave in different material medium.
CO2	Analyse the effect of various types of incidence and polarization of plane wave at the boundary and microwave signals applications.
CO3	Analyse the various parameters of electromagnetic waves propagating along the transmission lines (lossy and lossless) terminated with different types of loads.
CO4	Solve problems *arising* in transmission lines at various situations using graphical (smith chart) and analytical methods and applications of transmission lines.
CO5	Distinguish and compare construction and operation of different types of transmission lines and understanding of basic concepts of microwave devices.

<u>Course Articulation Matrix</u>

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	2	1										1
	2	3	2	1										2
	3	1	2	3										2
	4	2	2	2										2
	5	1	3	2										1
	Avg.	**2**	**2.2**	**1.4**										**1.6**

ELECTRONIC DEVICES

Contact Hours/ Week:	3 (L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4ETESC02	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Acquire the basics of semiconductor physics and electronic devices.
2.	Describe the mathematical models BJTs and FETs along with the constructional details.
3.	Understand the construction and working principles of optoelectronic devices
4.	Explain the fabrication process of semiconductor devices and CMOS process integration.

UNIT I
Semiconductors: Bonding forces in solids, Energy bands, Metals, Semiconductors and Insulators, Direct and Indirect semiconductors, Electrons and Holes, Intrinsic and Extrinsic materials, Conductivity and Mobility, Drift and Resistance, Effects of temperature and doping on mobility, Hall Effect
10 Hours

UNIT II
PN Junctions Forward and Reverse biased junctions-Qualitative description of Current flow at a junction, reverse bias, Reverse bias breakdown- Zener breakdown, avalanche breakdown, Rectifiers. Optoelectronic Devices Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors. Light Emitting Diode: Light Emitting materials.
8 Hours

UNIT III
Bipolar Junction Transistor: Fundamentals of BJT operation, Amplification with BJTS, BJT Fabrication, The coupled Diode model (Ebers-Moll Model),Switching operation of a transistor, Cut-off, saturation, switching cycle, specifications, Drift in the base region, Base narrowing, Avalanche breakdown.
8 Hours

UNIT IV
Field Effect Transistors: Basic pn JFET Operation, Equivalent Circuit and Frequency Limitations, MOSFET-Two terminal MOS structure- Energy band diagram, Ideal Capacitance-Voltage Characteristics and Frequency Effects, Basic MOSFET Operation, MOSFET structure, Current-Voltage Characteristics.
8 Hours

UNIT V
Fabrication of p-n junctions: Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapor deposition, photolithography, Etching, metallization. Integrated Circuits: Background, Evolution of ICs, CMOS Process Integration, Integration of Other Circuit Elements.
8 Hours

TEXT BOOKS		
1	Ben. G. Streetman, Sanjay Kumar Banerjee	"Solid State Electronic Devices",7th Edition, Pearson Education,2016, ISBN978-93-325-5508-2
2	Donald A Neamen, Dhrubes Biswas,	"Semiconductor Physics and Devices", 4th Edition, McGraw Hill Education, 2012, ISBN 978-0-07- 107010-2.

REFERENCE BOOKS		
1	S.M. Sze, KwokK.	Ng, "Physics of Semiconductor Devices", 3rd Edition, Wiley, 2018.
2	AdirBar-Lev	"SemiconductorandElectronicDevices",3rd Edition, PHI, 1993

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain the principles of semiconductor Physics
CO2	Compare the principles and characteristics of different types of semiconductor devices
CO3	Describe the fabrication process of semiconductor devices
CO4	Utilize the mathematical models of semiconductor junctions for circuits and systems.
CO5	Demonstrate proficiency in the fabrication techniques of p-n junctions and explaind CMOS process integration in Integrated Circuits (ICs).

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	3	2									2	
	2	3	3	3									2	
	3	2	2	3									2	
	4	2	3	3									2	
	5	1	2	3									2	
	Avg.	**2.2**	**2.6**	**2.8**									**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

PCB DESIGN

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4ETESC03	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Study about layout planning, art work and design of PCB
2.	To understand the PCB production process
3.	Discuss the role of Modern trends and automatic design of PCB

UNIT I
Design of Printed Circuit Boards: Layout Planning: Introduction, General Consideration, PCB Sizes, Layout Approaches, Documentation, Layout, General Rules and Parameters: Introduction, Resistance, Capacitance, Inductance of PCB conductors, Conductor Spacing, Component Placing and Mounting, Cooling Requirements and Package Density, Layout Check, Art work
10 Hours

UNIT II
Technology of PCB: Film Master Production: Introduction, Emulsion Parameters, Film Emulsions, Dimensional Stability of Film Masters, Reprographic Cameras, Darkroom, Film Processing, Film Registration, Properties of Copper Clad Laminates: Introduction, Manufacture of Copper Clad Laminates, Properties and Types of Laminates, Specifications and Test Methods, Board cleaning before Pattern Transfer: Manual and Machine Cleaning Processes
8 Hours

UNIT III
Photo printing: Basic Processes for Double Sided PCBs, Photoresists, Wet Film Resists, Coating Processes, Exposure and further Processing of Wet Film Resists, Dry Film Resists. Screen Printing: Screen Fabrics, Screen and Frame Preparation, Pattern Transfer onto the screen, Reclamation of the Screen Fabrics, Printing, Trouble shooting
8 Hours

UNIT IV
Plating: Introduction, Immersion Plating, Electroless Plating, Electroplating, Plating Quality Control, Etching, Etching Machines, Etchant Systems, Minimising Pollution, Mechanical Machining operations. Multilayer Boards: Introduction, Design and Test Considerations, Multilayer Construction, Equipment, Laminating Process and further processing
8 Hours
UNIT V
PCB Technology Trends: Fine line conductors with Ultra-Thin Copper Foil, Multilayer and Multiwire Boards, Flexible Printed Circuit Boards Automation and Computers in PCB Design: Automated Artwork Draughting, Computer Aided Design, Design Automation.
8 Hours

TEXT BOOKS		
1	Walter C Bosshart	Printed Circuit Boards-Design & Technology, Tata Mc Graw-Hill Pvt. Ltd, 2010
2	Dr. R.S. Khandapur	Printed Circuit Boards-Design, Fabrication, Assembly and Testing, Mc Graw-Hill Education, 2017

REFERENCE Web links and Video Lectures (e-Resources):	
1	PCB designing software YouTube links
2	NPTEL courses and videos

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Define the detailed circuit diagram and prerequisite before the actual PCB layout.
CO2	Understand the process of PCB production and Material selection
CO3	Understand the PCB fabrication by transferring the conductor pattern on base material
CO4	Know about the Plating techniques, Etching process and multilayer PCB board construction
CO5	Understand about new streams in PCB technology and modern facilities for PCB design

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											**PSO's**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	2	3	2	2							2	
	2	2	3	2	3	2							2	
	3	2	3	2	3	3							2	
	4	2	3	2	3	3							2	
	5	1	2	3	2	2							2	
	Avg.	**2**	**2.6**	**2.4**	**2.6**	**2.4**							**2**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

ENGINEERING STATISTICS AND LINEAR ALGEBRA

Contact Hours/ Week:	3(L)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4ETESC04	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand and Analyze Single and Multiple Random Variables, and their extension to Random Processes.
2.	Familiarize with the concept of Vector spaces and orthogonality with qualitative insight into applications in communications.
3.	Compute the quantitative parameters for the functions of single and Multiple Random Variables and Processes.
4.	Compute the quantitative parameters for Matrices and Linear Transformations.

UNIT I

Single Random Variables:
Definition of random variables, cumulative distribution function continuous and discrete random variables; probability mass function, probability density functions and properties; Expectations, Characteristic functions, Functions of single Random Variables, Conditioned Random variables. Application exercises to some special distributions: Uniform, Exponential, Laplace, Gaussian; Binomial, and Poisson distribution.

10 Hours

UNIT II

Multiple Random variables:
Concept, Two variable CDF and PDF, Two Variable expectations (Correlation, orthogonality, Independent), Two variable transformation, Two Gaussian Random variables, Sum of two independent Random Variables, Sum of IID Random Variables – Central limit Theorem and law of large numbers, Conditional joint Probabilities, Application exercises to Chi-square RV, Student-T RV, Cauchy and Rayleigh RVs.

8 Hours

UNIT III

Random Processes:
Ensemble, PDF, Independence, Expectations, Stationarity, Correlation Functions (ACF, CCF, Addition, and Multiplication), Ergodic Random Processes, Power Spectral Densities (Wiener Khinchin, Addition and Multiplication of RPs, Cross spectral densities), Linear Systems (output Mean, Cross correlation and Auto correlation of Input and output), Exercises with Noise

8 Hours

UNIT IV
Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations **Orthogonality:** Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram- Schmidt Orthogonalization procedure
8 Hours
UNIT V
Determinants: Properties of Determinants, Permutations and Cofactors **Eigenvalues and Eigen vectors:** Review of Eigenvalues and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition
8 Hours

TEXT BOOKS		
1	Richard H Williams	"Probability, Statistics and Random Processes for Engineers" Cengage Learning, 1st Edition, 2003, ISBN 13: 978-0-534-36888-3, ISBN 10: 0-534-36888-3.
2	Gilbert Strang	"Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN 97809802327

REFERENCE BOOKS		
1	Hwei P. Hsu,	"Theory and Problems of Probability, Random Variables, and Random Processes" Schaums Outline Series, McGraw Hill. ISBN 10: 0-07- 030644-3
2	K. N. HariBhat, K Anitha Sheela, Jayant Ganguly	, "Probability Theory and Stochastic Processes for Engineers", Cengage Learning India, 2019

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply the fundamental concepts of random variables, including CDFs, PMFs, and PDFs, to analyze various distributions such as Uniform, Exponential, Laplace, Gaussian, Binomial, and Poisson.
CO2	Analyze the joint behavior of multiple random variables using two-variable CDFs and PDFs, and apply the central limit theorem and law of large numbers to practical scenarios.
CO3	Characterize random processes, including stationarity, correlation functions, and power spectral densities, and apply these concepts to linear systems and noise analysis.
CO4	Develop a solid understanding of vector spaces, including basis, dimension, rank-nullity theorem, and apply orthogonality principles using the Gram-Schmidt orthogonalization procedure.
CO5	Apply matrix diagonalization and singular value decomposition to analyze and solve linear algebra problems involving special matrices.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO's	**1**	3	3	2										2
	2	3	3	3										2
	3	2	3	3										2
	4	3	2	2										2
	5	3	2	3										2
	Avg.	**2.8**	**2.6**	**2.6**										**2**

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

BIOLOGY FOR ENGINEERS

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	40	CIE Marks:	50
Sub. Code:	S4CCA01	SEE Marks:	50

Course Objectives:
This course will enable students to:

1.	To familiarize the students with the basic concepts of both biology and engineering.
2.	To enable the students with an understanding the concepts of biomolecules and its applications
3.	To provide the students to understand naturally designed biological organs (Brain and Heart) and engineering solutions
4.	To provide the students to understand naturally designed biological organs (Lungs, Kidney and muscular system) and engineering solutions
5.	To motivate the students develop trends in interdisciplinary vision of biological engineering.

General Instructions for Teaching-Learning

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

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students participation through audio-video based content creation for the syllabus (as assignments). Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students‟ seminars (in solo or group) /oral presentations.

UNIT I

Introduction: What is Biology, Development and evolution of life, difference between science and engineering with a suitable example of eye and camera. Understanding the Biomolecular interactions in biosystem.

Genetics and Darwinism: Mendelian Genetics, Darwinian evolution, study of inter and intra species relationships, developmental biology. Cellular structure and function, Organismal physiology-Energy and energetic constraints.

8 Hours

UNIT II
Biomolecules and Their Applications: Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching). Photosynthesis (photovoltaic cells), Echolocation (ultrasonography, sonars)
8 Hours
UNIT III
Human Organ Systems and Bio Designs - 1: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson"s disease). Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Human Blood substitutes hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).
8 Hours
UNIT IV
Human Organ Systems and Bio-Designs - 2: Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).
8 Hours
UNIT V
Trends in Bioengineering: Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio- imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).
8 Hours

TEXT BOOKS		
1	Krista Rompolski	Human Physiology, Stuart Fox, McGraw-Hill eBook., 16th Edition, 2022.
2	Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S. and Jaganthan M.K.	Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.

3	Arthur T. Johnson	Biology for Engineers, CRC Press, Taylor and Francis, 2011.
4	Leslie Cromwell	Biomedical Instrumentation, Prentice Hall 2011.
5	Sohini Singh and Tanu Allen	Biology for Engineers, Vayu Education of India, New Delhi, 2014.
6	Yoseph Bar-Cohen	Biomimetics: Nature-Based Innovation, CRC Press., Ist edition, 2012.
7	D. Floreano and C. Mattiussi	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press, 2008.
8	C R Sunilkumar, N Geetha, A C Udayashankar	Bioremediation of heavy metals: bacterial participation, Lambert Academic Publishing, 2019.
9	Ibrahim Ozbolat	3D Bioprinting: Fundamentals, Principles and Applications Academic Press, 2016.
10	Maria Rodriguez Mende	Electronic Noses and Tongues in Food Science, Academic Press, 2016
11	Robert Winslow	Blood Substitutes, Elsevier, 2005

E-RESOURCES	
1	VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2	https://nptel.ac.in/courses/121106008
3	https://freevideolectures.com/course/4877/nptel-biology-engineers- other-non-biologists
4	https://ocw.mit.edu/courses/20-020-introduction-to-biological- engineering-design-spring-2009.
5	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
6	https://www.coursera.org/courses?query=biology
7	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8	https://www.classcentral.com/subject/biology
9	https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Elucidate the basic concepts of relationship between Science and engineering.
CO2	Evaluate the concepts of biomolecules and its applications.
CO3	Analyse the behaviour of naturally designed biological organs (Brain and Heart) and engineering solutions.
CO4	Analyse the behaviour of naturally designed biological organs (Lungs, Kidney and muscular system) and engineering solutions.
CO5	Develop the trends in interdisciplinary vision of biological engineering.

UNIVERSAL HUMAN VALUES

Contact Hours/ Week:	1+0+0+0	Credits:	1
Total Lecture Hours:	13	CIE Marks:	50
Sub. Code:	SHS02	SEE Marks:	50

Pre-requisites: Universal Human Values (conducted during induction programme)

Course objectives: This course will enable students to:	
1.	Understanding of self-exploration about themselves (human beings), family, society and nature/existence.
2.	Appreciating the harmony in the human being, family, society and nature/existence
3.	Strengthening holistic perception of co-existence and mutual fulfilment among the four orders of nature.

UNIT I

Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'.

3 Hours

UNIT II

Understanding Harmony in self and body

Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease.

2 Hours

UNIT III

Understanding Harmony in the Family - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

3 Hours

UNIT IV		
Understanding Harmony in Society and Nature Understanding the harmony in the society (society being an extension of family)-Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.		
2 Hours		
UNIT V		
Understanding Harmony in all levels of Existence Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.		
3 Hours		
TEXT BOOKS		
1	Gaur, R.R. and Sangal R	Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2.
REFERENCE BOOK:		
1	Tripathi A.N.	Human Values, New Age International Publisher, 2003, ISBN: 81-224-1426-5.
E-RESOURCES		
1	Story of Stuff, http://www.storyofstuff.com	
2	https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw	
3	https://fdp-si.aicte-india.org/8dayUHV_download.php	
4	https://www.youtube.com/watch?v=8ovkLRYXIjE	
5	https://www.youtube.com/watch?v=OgdNx0X923I	

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Become more aware of themselves, and their surroundings (family, society, nature)
CO2	Become more responsible in life, and value human relationships and human society
CO3	Obtain better critical ability in handling problems and in finding sustainable solutions

ABILITY ENHANCEMENT COURSE
ADVANCED TECHNICAL TRAINING PROGRAM

Contact Hours/ Week:	2(P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S4CCA02	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Strengthen their understanding of C, C++ and Data Structures
2.	Write effective codes on C and C++ Programming

C Programming				
S. No	Topics covered	Learning outcome	Type of learning	Duration (Hours)

1	Introduction of Programming Languages
	• Structure of a 'C' Program
	  • Main function
	  • Input & Output
	  • 'C' Tokens
	• Keywords and Identifiers
	• Operators
	• Constants
	• Variables
	• Data Types
	• Scope and Lifetime of Variables
	Control Statements, if, if else, if else if ladder, switch cases and related programs, Looping & Branching - for loop, while loop and Do while loop, Conversion programs, Control Statement and Expressions.
	Array Concept - single dimensional arrays, Multidimensional arrays, String as Character arrays.
		To make the student to a level where he/she will start thinking about the logics of programs and will be thorough with the basic syntax and semantics of C programming language.	Classroom	6

2	Emphasis on Concepts of Pointers with implementation and MCQs, Array pointers, Structure & Union , Functions, Recursion, Enum, Type def, structures , union • Memory Allocation, static and Dynamic allocation, Storage class • FILE structure • Opening and closing a File, open modes	Understanding the user defined datatypes Advanced concepts of C.	Classroom	6
3	C Programming Lab - I	Important programs implementation in company point of view. Getting familiar with different	Lab	3

<table>
<tr><td colspan="5">DATASTRUCTURES</td></tr>
<tr><td>1</td><td>Introduction to Data Structures:
The factors that efficiency depends upon
1) Space complexity
2) Time complexity(step - count method)
• Classification of data structures:
• Linear data structures
• Nonlinear data structures
• Array vs. Linked List
• Types of linked list : singly , doubly, circular (introduction)
• Linked list
Types of linked list:
a) Singly linked list :
Applications, Operations on singly linked list
• Inserting a node: into an empty list, at beginning, at the end, at intermediate
• Deleting a node: form an empty list, at beginning, at the end, at intermediate
• Traversal
b) Circular linked list:
• Applications, Operations on circular linked list
c) Doubly linked list:
Applications, Operations on doubly linked list
• Difference between singly, doubly, circular
Stack:
• Push and Pop operation
• Applications Q
Queue:
• Enqueue and Dequeue operation Types of queue:
1. Normal queue(already discussed)
2. Circular queue : need of circular queue, applications, ensue, deqeue
3. Priority queue : need of priority queue, applications
4. Double ended queue : types
Applications of queue:
1. Client processing
2. Job scheduling
3. Music player</td><td>To make the student familiarized with the core DS concepts.
Sound conceptual understanding on linked lists and types, and applying them in programs.</td><td>Classroom</td><td>6</td></tr>
<tr><td>2</td><td>Searching Techniques:
• Linear Search (real life examples), explain the working with an example, Complexity Analysis
• Binary Search:</td><td>Programming strategies will be thoroughly explained for students</td><td>Classroom</td><td>6</td></tr>
</table>

	• Need of binary search • Working with example • Complexity Analysis Sorting Techniques: • *Bubble sort:* Introduction, Explain with example, Applications, Complexity analysis. • *Insertion sort:* Introduction, Explain with example, Applications, Complexity analysis. • *Selection sort:* Introduction, Explain with example, Applications, Complexity analysis. • *Quick sort:* Introduction, Explain with example, Applications, Complexity analysis. • *Merge Sort:* Introduction, Explain with example, Applications, Complexity analysis. Tree: • Why do we need a tree as a data structure? • Applications • Binary tree: Introduction, types of tree, important equations. • BST • Traversal: Preorder, In order, Post order, Level Graph: • Introduction • Terminologies in a graph • DFS • BFS Strategies: • Greedy algorithm • Divide and Conquer • Dynamic programming: • Shortest Path • Backtracking			
3	DS Programming Lab - I	Important DS programs implementation in company point of view.	LAB	3

SYSTEM DESIGN USING VERILOG

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S4ETA01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Develop a Verilog code to for the processing UNIT.
2.	Design and demonstrate generation of analog signals of desired specification on FPGA board
3.	Develop FPGA solutions for IoT applications using sensors and actuators.

List of Programs

1.	Demonstrate Full adder using transistor level modeling using FPGA board.
2.	Demonstrate processor modeling using FPGA board.
3.	Demonstrate the modeling of ALU using FPGA board.
4.	Demonstrate the modeling of memory using FPGA board.
5.	Demonstrate Universal shift register using FPGA board.
6.	Demonstrate the generation of different waveforms (square, triangle, sawtooth) using FPGA board.
7.	Demonstrate to control speed, direction of DC and stepper motor using FPGA board.
8.	Demonstrate to display number on the given seven segment display accepting Hex key pad input data using FPGA board
9.	Demonstrate to accept the 3-bit number from the dip switches and display its decimal equivalent number on seven segment display
10.	Demonstrate the counting the numbers from 0 to 9 and displaying on seven segment display using FPGA board. Include the following features. a. Start Count b. Reset Count c. Stop Count

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Design and implement basic digital circuits
CO2	Model and simulate a simple processor and arithmetic logic units (ALUs), gaining insights into how processors execute instructions and perform arithmetic operations.
CO3	Model and simulate different types of memory units and universal shift registers, understanding the storage, retrieval, and manipulation of data in digital systems.
CO4	Generate various waveforms (square, triangle, saw tooth) using digital-to-analog converters (DACs) and adjust their frequency
CO5	Interface and control peripherals such as DC and stepper motors, and seven-segment displays, enhancing their skills in hardware-software integration and real-time system control.

Course Articulation Matrix

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

CO's		PO's											PSO's	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
	1	2	2										1	
	2	2	1	1		2							2	
	3	2	2	2		3							2	
	4	2	2	2		2							2	
	5	2	2	2		2							2	
	Avg.	**2**	**1.8**	**1.75**		**2.25**							**1.8**	

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

DATA STRUCTURES LAB USING C

Contact Hours/ Week:	2 (P)	Credits:	1
Total Labs:	14	CIE Marks:	50
Sub. Code:	S4ETA03	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Develop and implement Linear data structures and their applications such as stacks, queues using static memory allocation.
2.	Develop and implement Linear data structures such as linked lists using dynamic memory allocation.
3.	Explore the applications of linked lists, develop and implement them.
4.	Develop and implement Non-Linear data structures such as trees and their applications

List of Programs

1. Write a C program to create a sequential file (or array of structure) with at least five records, each record having the structure shown below:

EMPLOYEE_ID	NAME	DEPARTMENT	SALARY	AGE
Non-Zero Positive integer	25 Characters	25 Characters	Positive Integer	Positive integer

Write necessary functions to perform the following operations:

a) to display all the records in the file.(or array of structures)
b) to search for a specific record based on EMPLOYEE_ID.

2. Develop and implement a STACK of integers using array and perform the following operations: (a) PUSH (b) POP (c) DISPLAY and (d)check whether the contents of stack form a palindrome.

3. Develop and implement linear QUEUE of strings using array and perform the following operations: (a) insertion, (b) deletion and (c) display.

4. Develop and implement CIRCULAR QUEUE of integers using array and perform the following operations: (a) insertion, (b) deletion and (c) display.

5. Develop and implement singly linked list with integer data and perform the following operations:
   a. to insert a node at the end of the list.
   b. to delete the first node in the list.
   c. to insert a node at the specified position in the list (1<=pos<=n where 8n9 is the total number of nodes in the list & 8pos9 is the position where data is to be inserted).
   d. to display the contents of the list.
   e. to reverse a given list.

6.	Develop and implement a STACK of integers using singly linked list and perform the following operations: (a) PUSH (b) POP (c) DISPLAY.
7.	Develop and implement linear QUEUE of integers using singly linked list and perform the following operations: (a) insertion, (b) deletion and (c) display
8.	Develop and implement doubly linked list the following operations: a. Insert a node at the end of the list. b. Insert a new node next to a node whose information field is specified. c. To delete first node if pointer to the last node is given. d. To delete a node whose information is given. e. To display the contents of the list. f. To swap n^{th} and m^{th} nodes in the list.
9.	Develop and implement DEQUE using doubly linked list to perform the following operations: insertion, deletion and display.
10	Develop and implement binary search tree (BST) of integers to perform the following operations: a. Insert into a BST. b. Traverse the tree in inorder/ preorder/ postorder. c. Delete a given node from the BST.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Design and develop C programs by applying C programming techniques like pointers, structures and files to develop solutions for particular problems.
CO2	Design and develop Linear data structures like Stack, Queue using static memory allocation technique and explore their applications.
CO3	Design and develop Linear data structures like Linked Lists using dynamic memory allocation technique.
CO4	Apply the knowledge of linked lists to design and develop solutions to given problems.
CO5	Apply the knowledge of dynamic memory allocation technique to develop and implement non-linear data structures like Trees and their applications.

<u>Course Articulation Matrix</u>

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO's	1	2		2									2	
	2	2		2									2	
	3	2		2									2	
	4	2	2										2	
	5	2	2										2	
	Avg.	**2**	**2**	**2**									**2**	

CIRCUIT ANALYSIS

Contact Hours/ Week:	: 2(P)	Credits:	1
Total Practical Hours:	: 28	CIE Marks:	50
Sub. Code:	: S4ETA04	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the usage of modern tools to analyze given electrical and electronic circuits.
2.	Design an electronic system and implementation using hardware.

List of experiments:

1. Star-Delta transformation.
2. Source shifting and transformation.
3. Loop analysis of electrical circuit with independent sources.
4. Nodal analysis of electrical circuit with independent sources.
5. Circuit analysis with dependent sources.
6. Verification of Thevenin's & Norton's theorem.
7. Verification of Superposition theorem.
8. Verification of Maximum power transfer theorem.
9. Resonance.
10. Transient Analysis of RL and RC circuits.

E-RESOURCES

1	https://www.youtube.com/watch?v=JRcyHuyb1V0
2	https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
3	https://nptel.ac.in/courses/106105165

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Apply Circuit laws and analyse an electrical system using LT-Spice.
CO2	Analyse and design an electronic system and implement using virtual lab.

Course Articulation Matrix

CO'S		PO's											PSO's	
		1	2	3	4	5	6	7	8	9	10	11	1	2
	1	3	2			2					1		2	
	2	3	2			2					1		2	
	Avg.	3	2			2					1		2	