SCHEME & SYLLABUS

OF

III & IV SEMESTERS B.E.

ELECTRONICS AND COMMUNICATION ENGINEERING

AY: 2025-26

(Applicable to 2024-25 Batch)

Vision

To be a center of excellence in education and research creating professionally competent and socially sensitive Electronics and Communication engineers capable of working in multicultural global environment.

Mission

- To provide quality education relevant to the current and future needs of the society ensuring experiential learning in Electronics and Communication engineers.
- To create state of the art infrastructure and research facility for learning-teaching-learning process and quality research.
- To imbibe professional ethics, human values and competency in students enabling them to work individually, and as a member or leader in multicultural global environment

Programme Educational Objectives:

The graduates of Electronics and Communication engineering programme will

a) Be able to design and build systems for providing solutions to real life problems in the area of Electronics and Communication.
b) Be a successful entrepreneur, build careers in Industry, government, public sector undertakings, pursue higher education and research.
c) Work individually, within multidisciplinary teams and lead the team following sound professional and ethical practices.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Graduate attributes: Program Outcomes (POs)

PO1: **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: **Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: **Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

A graduate of the Electronics and Communication Engineering Program will demonstrate

1. The ability to analyse and design systems in the areas related to microelectronics, Communication, Signal Processing and embedded systems for solving real world problems (Professional Skills).

2. The ability to identify problems in the areas of communication and embedded systems and provide efficient solutions using modern tools/algorithm individually or working in a team (Problem solving Skills).

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

I Semester (Chemistry Cycle) **Electrical & Electronics Engg. Stream (EE, EC, EI, ET)**

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATE1	Mathematics - I for EEE Stream	Maths	2	2	2	0	3	50	50	100	4
2	ASC(IC)	CHEE	Chemistry for EEE Stream	Che	3	0	2	0	3	50	50	100	4
3	ESC	ESCF1	Computer Aided Engineering Drawing	ME	2	0	2	0	3	50	50	100	3
4	ESC2	ESCOx	Engineering Science Course-I	ABE	3	0	0	0	3	50	50	100	3
5	PLC	PLCx	Programming Language Course	ABE	2	0	2	0	3	50	50	100	3
6	AEC	CC01	Communicative English	T&P	1	0	0	0	1:30	50	50	100	1
7	HSMC	CC05	Indian Constitution	HS	1	0	0	0	1:30	50	50	100	1
8	AEC/SDC	CC07	Scientific Foundations of Health	Any Dept.	1	0	0	0	1:30	50	50	100	1
		AAP	AICTE Activity Points	40 hours of work to be documented and produced for the examination at 8th Semester									
			Total							400	400	800	20

Note: 1) *Students have to choose any one course out of five options available in* ***Engineering Science Courses (Optional).***
2) *Students have to choose any one course out of five options available in* ***Programming Language Courses***

Code	Engineering Science Courses (Optional)	L	T	P	Cr	Code	Programming Language Courses	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3	PLC1	Introduction to Web Programming	2	0	2	3
ESCO2	Introduction to Electrical Engg. (Excluding EE)	3	0	0	3	PLC2	Introduction to Python Programming	2	0	2	3
ESCO3	Introduction to Electronics Engineering(Excluding EC, EI, ET)	3	0	0	3	PLC3	Basics of JAVA programming	2	0	2	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3	PLC4	Introduction to C++ Programming	2	0	2	3
ESCO5	Introduction to C Programming	2	0	2	3						

ASC(IC)	Applied Science Course (Integrated Course)	**HSMC**	Humanities, Social Science and Management Course
ESC	Engineering Science Course	**AEC**	Ability Enhancement Course
ETC	Emerging Technology Course	**SDC**	Skill Development Course
PLC	Programming Language Course	**ABE**	Appropriate Branch of Engineering

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

II Semester (Physics Cycle) **Electrical & Electronics Engg. Stream (EE, EC, EI, ET)**

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATE2	Mathematics - II for EEE Stream	Maths	2	2	2	0	3	50	50	100	4
2	ASC(IC)	PHYE	Physics for EEE Stream	Phy	3	0	2	0	3	50	50	100	4
3	ESC	ESCF3	Elements of Electrical Engg. (For EE)	EE	2	2	0	0	3	50	50	100	3
		ESCF4	Basic Electronics (for EC, EI, ET)	EC	3	0	0	0					
4	ESC1	ESCOx	Engineering Science Course-II	ABE	3	0	0	0	3	50	50	100	3
5	ETC	ETCxx	Emerging Technology Course	ABE	3	0	0	0	3	50	50	100	3
6	AEC	CC02	Professional Writing Skills in English	T&P	1	0	0	0	1:30	50	50	100	1
7	HSMC	CC03 CC04	Balake Kannada Samskruthika Kannada	HS	1	0	0	0	1:30	50	50	100	1
8	AEC/SDC	CC06	Innovation and Design Thinking	Any Dept.	1	0	0	0	1:30	50	50	100	1
		AAP	AICTE Activity Points	40 hours of work to be documented and produced for the examination at 8th Semester									
			Total							400	400	800	20

Note: 1) *Students have to choose any one course out of five options available in **Engineering Science Courses (Optional)** excluding Engineering Science Course studied in I Semester.*

2) *Students have to choose any one course out of four options available in **Emerging Technology Courses***

Code	Engineering Science Courses (Optional)	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3
ESCO2	Introduction to Electrical Engg. (Excluding EE)	3	0	0	3
ESCO3	Introduction to Electronics Engg. (Excluding EC, EI, ET)	3	0	0	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3
ESCO5	Introduction to C Programming	2	0	2	3

Code	Emerging Technology Courses	L	T	P	Cr
ETC01	Smart Materials and Systems	3	0	0	3
ETC02	Green Buildings	3	0	0	3
ETC03	Operation and Maintenance of Solar Electric Systems	3	0	0	3
ETC04	Introduction to Embedded System	3	0	0	3
ETC05	Introduction to Nanotechnology	3	0	0	3
ETC06	Introduction to Drone Technology	3	0	0	3
ETC07	Introduction to Sustainable Engineering	3	0	0	3
ETC08	Renewable Energy Sources	3	0	0	3
ETC09	Waste Management	3	0	0	3
ETC10	Emerging Applications of Biosensors	3	0	0	3
ETC11	Introduction to Internet of Things (IoT)	3	0	0	3
ETC12	Introduction to Cyber Security	3	0	0	3

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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B.E. in Electronics and Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (2024 Scheme) (w.e.f. 2025-26)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs.					Examination				Total Credits (C) (Total hrs/30)
					Class room Instruction (CI) (in hrs/sem)	Tutorial	Lab Instruction (LI) (in hrs/sem)	Term work (TW) and Self Learning (SL) (TW+SL) (in hrs/sem)	Total No. of hrs/sem	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S						
1.	IPCC	S3ECI01	Mathematics for Signal Processing	ECE	42	-	28	50	120	3	50	50	100	4
2.	PCC	S3EC05	Random Process	ECE	42	-	-	48	90	3	50	50	100	3
3.	IPCC	S3ECI02	Digital Electronic Circuits with Verilog	ECE	42	-	28	50	120	3	50	50	100	4
4.	PCC	S3EC06	Analog Electronic Circuits	ECE	42	-	-	48	90	3	50	50	100	3
5.	PCCL	S3ECL01	Analog Electronic Circuits Lab	ECE	-	-	28	02	30	3	50	50	100	1
6.	ESC	S3ECXX	ESC/ETC/PLC	ECE	42	-	-	48	90	3	50	50	100	3
7.	UHV	SHS01	Social Connect and Responsibility	ME	-	-	28	02	30	-	100	-	100	1
8.	AEC/ SEC	S3ECAX X	Ability Enhancement Course/ Skill Enhancement Course - III	ECE	If offered as Theory Course					1½	50	50	100	1
					If offered as Integrated Course					1½				
					-	-	28	02	30					
9.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO							100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED										
		SMC03	Yoga	PED										
		SMC04	NCC											
			Total								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 L: Lecture, T: Tutorial, P: Practical, S= SDA: Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Offered by the Department)	
S3EC02 - Computer Organization & Architecture	S3EC04 - Applied Numerical Methods for EC Engineering
S3EC03 - Electronic Measurements	S3EC07 - VLSI Process Technology
Ability Enhancement Course – III (Offered by the Department)	
S3ECA01 - Electronic System Design	S3ECA04 - Signal Processing with R
S3ECA02 - Matlab for EC Engineering	S3ECA05 - Electric Circuit Analysis

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B.E. in Electronics and Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (2024 Scheme) (w.e.f. 2025-26)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs.					Examination				Total Credits (C) (Total hrs/30)
					Class room Instruction (CI) (in hrs/sem) L	Tutorial T	Lab Instruction (LI) (in hrs/sem) P	Term work (TW) and Self Learning (SL) (TW+SL) (in hrs/sem) S	Total No. of hrs/sem	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1.	PCC	S4EC01	Communication System – 1	ECE	42	-	-	48	90	3	50	50	100	3
2.	IPCC	S4ECI02	Control Systems	ECE	42	-	28	50	120	3	50	50	100	4
3.	IPCC	S4ECI07	ARM Microcontroller	ECE	42	-	28	50	120	3	50	50	100	4
4.	PCCL	S4ECL01	Communication System – 1 Lab	ECE	-	-	28	02	30	3	50	50	100	1
5.	ESC	S4ECXX	ESC/ETC/PLC	ECE	42	-	-	48	90	3	50	50	100	3
6.	BSC	S4CCA01	Biology for Engineers	BT, CH, Phy, Che	42	-	-	48	90	3	50	50	100	3
7.	UHV	SHS02	Universal Human Values Course	IEM	14	-	-	16	30	1½	50	50	100	1
8.	AEC/ SEC	S4ECAXX	Ability Enhancement Course/ Skill Enhancement Course - IV	ECE	If offered as Theory Course					1½	50	50	100	1
					If offered as Integrated Course									
					-	-	28	02	30	1½				
9.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO							100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED										
		SMC03	Yoga	PED										
		SMC04	NCC											
			Total								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 L: Lecture, T: Tutorial, P: Practical S= SDA: Skill Development Activity,
CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Offered by the Department)	
S4EC03 - Fields, Lines and Waves	S4EC05 - Solid State Devices & Technology
S4EC04 - Industrial Electronics	S4EC06 - Data Structures with C
Ability Enhancement Course – IV (Offered by the Department)	
S4ECA01 - Communication Applications using Python	S4ECA03 - Advanced Digital Design using System Verilog
S4ECA02 - Industrial IoT	S4ECA04 - Communication Systems using GNU Radio
S4CCA02 – Advanced Technical Training-C++ Lab	

Subjects taught from I year to IV year in the following four streams

Stream	I/II Sem	III/IV Sem	V/VI Sem	VII/VIII Sem	Electives
Microelectronics	• Basic Electronics	• Analog Electronic Circuits • Digital Electronic Circuits • Electric Circuit Analysis • Control Systems • VLSI Process Technology	• Digital VLSI Design	• Synthesis and Timing Analysis	• Low Power VLSI • Smart Materials and Smart System • Analog and Mixed mode VLSI Design • ASIC Design • VLSI Testing and Verification • Sensors for Biomedical Applications
Signal Processing		• Mathematics for Signal Processing • Random Process	• Digital Signal Processing		• Advanced Signal Processing • Medical Image Processing • Digital Image Processing • Data Science • Speech Processing • Artificial Neural Networking • Machine Learning • Deep Learning

Stream	I/II Sem	III/IV Sem	V/VI Sem	VII/VIII Sem	Electives
Communication and Networking		• Fields, Lines and Waves • Communication System-I	• IoT & Network Technology • Communication Systems-II • Communication Systems-III	• Cryptography and network security	• Error Control Coding • Optical Fiber Communication • Edge and Cloud Computing • Satellite Communication • Software Defined Networks • RF and Microwave Circuit Design • Radars system for Autonomous Driving • MIMO Wireless communication • Advanced Multimedia • Introduction to Quantum Information and Computing
Embedded Systems	• Introduction to IoT	• Computer Organization and Architecture • ARM Microcontroller			• Embedded System Design • Automotive Embedded system Design • Advanced Computer Architecture • System on Chip

III SEM SYLLABUS

MATHEMATICS FOR SIGNAL PROCESSING

Contact Hours/ Week:	: 3+0+2	Credits:	4
Total Lecture Hours:	: 42	CIE Marks:	50
Total Practical Hours	: 28	SEE Marks:	50
Sub. Code:	: S3ECI01		

Course objectives:	
This course will enable students to:	
1.	Study the characteristics, representation and properties of signals and systems in time as well as frequency domains.
2.	Evaluate the behaviour of an LTI system.
3.	Apply transformations on signals.

UNIT I
Introduction to Signals: Definition of signals and systems, Mathematical Representation, Classification of signals, Operations on signals, Elementary signals, Signals and Vectors: component of a vector, Component of a signal Orthogonality in complex signals, Energy of the sum of orthogonal signals.
9 Hours

UNIT II
Time Domain Representation of LTI Systems: Introduction, Properties of systems, impulse response representation of LTI systems, Response of the LTI systems: linear convolution using graphical method, Properties of impulse response representation.
9 Hours

UNIT III
Fourier representations for signals: Introduction, Discrete Time non periodic signals: DTFT & IDTFT representations, Continuous Time non periodic signals: FT & IFT representation, Properties of DTFT & FT.
8 Hours
UNIT IV
Applications of Fourier representations: Introduction, Frequency response of LTI systems, Application of DTFT to compute impulse response. Fourier Transform representation of periodic signals.
8 Hours
UNIT V
Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform by Partial fraction expansion method, Transform analysis of LTI systems, stability & causality.
8 Hours

TEXT BOOKS		
1	Simon Haykin, Barry Van Ven	Signals and systems, John Wiley, Ed 2, Indian Ed, 2008.
2	J. G. Proakis & D. G.Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, PHI, 4th Edition, 2014.
REFERENCE BOOKS		
1	Sanjit K. Mitra	Digital Signal Processing: A Computer-Based Approach. TMH. 4th Edition, 2013.
2	H.P. HSU	Schaum's Outlines- Signals & Systems, TMH, 2nd Edition, 2010.
3	Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab	Signals & Systems, PHI, 2nd Edition, 2014.
4	B P Lathi	Principles of Signal Processing and Linear systems, Oxford University Press, 8th Edition, 2014.

E-RESOURCES	
1	https://nptel.ac.in/courses/117101055
2	https://www.digimat.in/nptel/courses/video/108104100/L02.html
3	https://nptel.ac.in/courses/117104074
4	https://archive.nptel.ac.in/courses/108/106/108106163
5	https://www.youtube.com/watch?v=wMflxR3KsXg

Course Outcomes:

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

CO1	Apply knowledge of Mathematics and Engineering fundamentals to Identify and characterize different classes of signals.
CO2	Identify, formulate the methodology to compute the response and analyze the properties of an LTI system.
CO3	Identify Fourier Representations and analyze the signals in time and frequency domain.
CO4	Apply Fourier representations to compute the characteristics of LTI systems in both time and frequency domain.
CO5	Apply ZT for broader characterization of discrete time signals and LTI systems.
CO6	Analyze deterministic signals and LTI systems in both Time and frequency domains using MATLAB/Python.

Integrated Lab:

List of Experiments:

1. Generation of Real Signals: periodic, non-periodic, Discrete, continuous, signals.
2. Complex signal representation & computing energy of signals
3. Operations on Signals
4. Response calculation of discrete time LTI system: Linear convolution
5. Step response of a given system
6. Frequency domain representations of single tone and multi tone sinusoidal signals
7. Time and Frequency domain representation using DTFT
8. Spectral analysis using FS
9. Frequency response of discrete time system
10. Stability analysis and causality analysis : Pole-Zero plot, magnitude and phase response from a difference equation

Course Articulation Matrix

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

RANDOM PROCESS

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	: S3EC05	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Introduce students to concept of probability theory
2.	Apply random variable theory to analyze real world systems

UNIT I

Introduction: A Speech recognition system, A communication network, A Radar System, Introduction to Probability Theory: Experiments, sample space, Events, Axioms, Joint and conditional probabilities,. Baye's Theorem, Independence, Discrete Random Variables, Cumulative distribution function (CDF), Probability density function (PDF), Standard random variables, Gaussian RV, Uniform RV, Binomial RV, Poisson RV.

Engineering application-An optical communication system.

9 Hours

UNIT II

Operations on a Single R V: Expected value, Expected value of functions of Random variables, Moments, Central Moments, Transformation of Random variables.

Engineering application-Scalar quantization, Discrete binary source, Entropy and source coding.

8 Hours

UNIT III
Pairs of Random variables: Joint Cumulative distribution function, Joint Probability density function, Joint probability mass functions, Expected values involving pairs of Random variables, Independent Random variables, Jointly Gaussian Random variables. **Engineering application**-Mutual information, Channel capacity and channel coding.
9 Hours
UNIT IV
Multiple Random Variables: Joint and conditional probability mass functions, CDF, PDF, Expected value involving multiple Random variables, Gaussian Random variable in multiple dimensions. **Engineering application-**Linear prediction of speech.
8 Hours

UNIT V
Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodicity, Properties of Autocorrelation function and Power spectral density, White noise process, Example Processes: Markov processes, Gaussian Processes.
8 Hours

TEXT BOOKS		
1	S L Miller and D C Childers	Probability and Random processes: with applications to Signal processing and communication Academic Press/ Elsevier, 2nd Edition, 2014.

REFERENCE BOOKS		
1	A. Papoullis and S U Pillai	Probability, Random variables and stochastic processes McGraw Hill, 4th Edition, 2002.
2	Peyton Z Peebles	Probability, Random variables and Random signal principles TMH, 4th Edition, 2007.
3	H Stark and Woods	Probability, statistics and random processes for engineers, Pearson, 2012.

E-RESOURCES	
1	https://archive.nptel.ac.in/noc/courses/noc15/SEM2/noc15-ec07/
2	https://www.youtube.com/watch?v=wMflxR3KsXg

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Illustrate the knowledge of basics of probability and random variable theory to represent uncertainty (variability).
CO2	Identify various parameters that describe important features of a random variable and use them to analyze randomness in data.
CO3	Model Natural phenomena using pairs of random variables.
CO4	Use matrix notation to represent and analyze multidimensional random variables.
CO5	Analyse real world systems/applications using random processes.

Course Articulation Matrix

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

DIGITAL ELECTRONIC CIRCUITS WITH VERILOG

Contact Hours/ Week:	3+0+2	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	28	SEE Marks:	50
Sub Code:	S3ECI02		

Course objectives:

This course will enable students to :

1.	Simplify Boolean expressions using K Maps.
2.	Analyze and design combinational logic circuits and develop Verilog codes for the same.
3.	Analyze and design sequential logic circuits and develop Verilog codes for the same.
4.	Analyze and design combinational circuits using PLDs.

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.

9 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.

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.

9 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.

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, Pearson Education, 2nd Edition, 2003.

REFERENCE BOOKS		
1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, Pearson, 12th Edition, 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, Pearson Education, 5th Edition, 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 build Verilog code for the same
CO3	Implement shift registers and counters by selecting Flip Flops and develop Verilog code.
CO4	Design Finite state machine using Mealy model
CO5	Analyze different memories and design logic circuits using programmable logic devices.

Course Articulation Matrix

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

Integrated Lab: **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 and implementation of mod counters
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

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	: S3EC06	SEE Marks:	50

Course objectives:

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

Device structure, Operation, i_D–v_{DS} characteristics, MOSFET Circuit at DC. MOSFET operation as a switch and as a Linear Amplifier (qualitative analysis). MOSFET biasing by fixing VGS, Biasing by fixing VG and connecting a resistance in the source, Biasing Using a Drain to Gate feedback Resistor, Constant-Current-Source Biasing (using current mirror).

9 Hours

UNIT II

DC Bias Point, Signal Current in the Drain Terminal, Voltage Gain, Small-Signal equivalent-circuit models, Trans conductance gm, The T-equivalent Circuit model. Common Source Amplifier, Common Source Amplifier with Source Resistance, Common Gate Amplifier (qualitative analysis), Common Drain Amplifier (qualitative analysis), Comparison. High-Frequency Model, Frequency Response of CS Amplifier (qualitative analysis), Cascode amplifiers.

9 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
Review of Op-Amp, Various applications of Op-Amp like Comparator, Zero-crossing detector, Instrumentation amplifier, Square wave generator, Schmitt trigger, Precision rectifier, peak detector, sample and hold circuit. Filters: First and second order low-pass and high-pass Butterworth filter, Band-pass filters, Band reject filters, All pass filters (qualitative analysis).
8 Hours

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

TEXT BOOKS		
1	Adel S. Sedra, Kenneth Carless Smith	Microelectronic Circuits Theory and Applications, Oxford University Press, 7th Edition. 2017.
2	Behzad Razavi	Fundamentals of Microelectronics, Wiley, 3rd Edition, 2021.
3	Sergio Franco	Design with Operational amplifiers and Analog Integrated circuits, Mc Graw Hill, 4th Edition, 2014.

REFERENCE BOOKS		
1	Robert L. Boylestad and Louis Nashelsky.	Electronic Devices and Circuit Theory. 10th Edition, PHI, 2009.
2	Robert F. Coughlin and Frederick F, Driscoll.	Operational Amplifiers and Linear integrated Circuits, PHI, 6th Edition, 2000.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyse the MOSFET structure, working and design of biasing circuit.
CO2	Design the CS, CG, CD and Differential amplifiers and compare the performance
CO3	Analyze Power amplifiers and design Class A, Class B power amplifiers.
CO4	Design Opamp based applications such as comparator, Instrumentation amplifier, Schmitt trigger, waveform generators, rectifiers and filters.
CO5	Design circuits using Timer, PLL, ADC and DAC ICs and Op-Amps

Course Articulation Matrix

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

ANALOG ELECTRONIC CIRCUITS LAB

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S3ECL01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Design and demonstrate various applications of diodes.
2.	Design and analysis of amplifiers using MOSFET.
3.	Design and analysis of various applications of Linear IC's.

PART - A: Rig up Experiments:

1. Regulated DC power supply.
2. Digital to Analog Converters.
3. Class-B push pull power amplifier.
4. Instrumentation amplifier
5. Schmitt trigger using op-amp.

PART - B: Rig Up Experiments using Analog Discovery 2 – NI Edition Kit

6. Clippers and Clampers.
7. Precision Rectifiers using op-amp
8. Monostable multivibrators using 555 timer
9. Astable multivibrators using 555 timer
10. MOSFET amplifier (common source)

Open Ended Experiments

1. Design and testing of variable regulated DC power supply.
2. Interfacing Mic and Speaker through IC power amplifier.

3.	Write the block diagram for a scheme which pumps water from ground floor to overhead tank and design a circuitry which will show the water level of the overhead tank.
4.	Driving a relay using ULN 2003 drivers to switch ON appliances.
5.	Design a data acquisition system to display temperature in a range of _____ and with an accuracy of _____ %.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Identify a suitable electronic device and design, rig-up, demonstrate the various analog circuits for given specifications and interpret the results.
CO2	Use modern tool to design and test the working principle of analog electronic circuits.
CO3	Demonstrate ability to provide efficient solutions for complex engineering problems in the area of microelectronics individually and working in a team.

Course Articulation Matrix

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**		2	2					2	2			2	2
	CO2	2		2		2			2	2			2	2
	CO3		2	2		2		2	2	2			2	

ENGINEERING SCIENCE COURSES

COMPUTER ORGANIZATION AND ARCHITECTURE

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3EC02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Articulate the operational concepts and programming techniques of general purpose computer
2.	Appraise the Input output organization and memory system
3.	Illustrate the operations of different blocks of computer system

UNIT I

Basic Structure of Computers:

Basic Operational Concepts, Performance – Processor Clock, Basic Performance Equation, Clock Rate.

Machine Instructions and Programs:

Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language.

9 Hours

UNIT II

Machine Instructions and Programs (contd..):

Stacks, Subroutines, Additional Instructions, Encoding of Machine Instructions.

Input /Output Organization:

Accessing I/O Devices, Interrupts, Bus structure, Direct Memory Access.

8 Hours

UNIT III
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Memory Hierarchy, Cache Memories – Mapping Functions, Replacement techniques, cache write policies.
8 Hours
UNIT IV
Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Multiplication of Signed Numbers, Integer Division.
8 Hours

UNIT V
Processing Unit: Fundamental Concepts, Execution of a Complete Instruction: Load Instructions, Arithmetic and Logic Instructions, Store Instructions Hardware Components: Register File, ALU, Data path, Instruction Fetch and Execution Steps, Parallel Processing: SISD, SIMD, MISD, MIMD, Pipelining: general considerations, speed up.
9 Hours

TEXT BOOKS		
1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	Computer Organization and Embedded systems, Tata McGraw Hill, 6th Edition, 2012.
2	M. Morris Mano	Computer System Architecture, Pearson, 3rd Edition, 2017.

REFERENCE BOOKS		
1	William Stallings:	Computer Organization & Architecture, Pearson, 9th Edition, 2015.
2	David A. Patterson and John L. Hennessy	Computer Organization and Design: The Hardware/Software interface, Elsevier, 3rd Edition, 2005.

E-RESOURCES	
1	https://archive.nptel.ac.in/courses/106/105/106105163/
2	https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation-architecture
3	https://drive.google.com/file/d/1jgy5Kb_jrPDCbVUCX7DDRWthQYRpI8lE/view

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Demonstrate machine instructions, addressing techniques, and instruction sequencing.
CO2	Analyze the instruction set and interrupt concepts of a general computer system
CO3	Illustrate the functionalities of different memory organizations
CO4	Analyze the implementations of arithmetic operations
CO5	Illustrate the functionalities of processor architecture

Course Articulation Matrix

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

ELECTRONIC MEASUREMENTS

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3EC03	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Have in depth knowledge of measurement methods and instruments of electrical quantities.
2.	Understand design aspects and performance criterion for measuring instruments.
3.	Implement and analyze different signal generators and displays.
4.	Understand the working principle of transducers.

UNIT I

Introduction to Basic Instruments: Static and dynamic characteristics of instrument: accuracy, precision, resolution, sensitivity, linearity threshold, calibration, Significant figure, Errors in Measurement: Gross errors and systematic errors, Absolute and relative errors.

Standards of measurements: Classification of standards, IEEE standards

8 Hours

UNIT II

Measurements of resistance, inductance and capacitance: Wheatstone bridge, Kelvin's bridge, High resistance measurement using Megger, AC bridge and their applications-Maxwell's bridge, Hay's bridge, Schering's bridge, Wien's bridge. Types of detectors in AC bridges, Shielding and grounding of bridges, Digital LCR meter.

8 Hours

UNIT III
Voltage and Current Measurements: Introduction, Average responding voltmeter, peak responding voltmeter, True RMS voltmeter, resolution and sensitivity of digital meters, Ramp type DVM, Dual slope integrating type DVM, Integrating type DVM, Successive approximation type DVM, Continuous balance DVM, Microprocessor based Ramp type DVM, Digital Multi-meter.
9 Hours

UNIT IV
Display devices, Recorders and Signal generators:
Display devices: Digital display system, classification of display, LEDs, LCD displays, Digital Storage Oscilloscope, Digital recorders.
Signal generators: Function generators, RF Signal generators, Sweep signal generator. (Block diagram, theory and applications only)
8 Hours

UNIT V
Transducers and Data acquisition and conversion: Basics of Transducers/Sensors: Characteristics of Transducers; Requirement of Transducers; Classification of transducers; Selection Criteria of Transducers. Displacement: Potentiometers; Linear Variable Differential Transformer, Resistance Strain Gauges, Capacitance Sensors. Temperature: RTD, Thermisters, Thermocouples- Their Ranges, and Applications.
9 Hours

TEXT BOOKS		
1	H. S. Kalsi	Electronic Instrumentation, TMH, 3rd edition, 2014.
2	David A Bell	Electronic Instrumentation and Measurements, Pearson Education, 3rd edition, 2013.

REFERENCE BOOKS		
1	John P. Bentley	Principles of measurement systems, Pearson Education, 4th Edition, 2004.
2	Cooper D & A D Helfrick	Modern electronic instrumentation and measuring techniques, PHI/Pearson Education, 2nd Edition, 2008.
3	A K Sawhney	Electronics & electrical measurements, Dhanpat Rai & Sons, 9th edition. 2011.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply knowledge of Engineering fundamentals to characterize different measurement parameters of an instrument.
CO2	Analyze and design the dc and ac bridge networks to determine the values of resistance, inductance and capacitance.
CO3	Identify the different types of measuring instruments like digital voltmeter and multimeter.
CO4	Identify the different types of signal generators and compare display devices.
CO5	Identify the different types of transducers to measure temperature, pressure and displacement.

Course Articulation Matrix

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

APPLIED NUMERICAL METHODS FOR EC ENGINEERING

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3EC04	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	To provide the knowledge and importance of error analysis in engineering problems.
2.	To represent and solve an application problem using a system of linear equations.
3.	Analyze regression data to choose the most appropriate model for a situation.
4.	Familiarize with the ways of solving complicated mathematical problems numerically.
5.	Prepare to 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-Off errors, 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.

8 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.
9 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 1/3rd rule. Solution of linear difference equations. Boundary-Value Problems, Introduction. The Shooting Method, Finite-Difference Methods.
9 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 & Raymond P. Canale	Numerical Methods for Engineers and Scientists, McGraw Hill, 8th Edition, 2020.
2	Steven C. Chapra	Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw Hill, 5th Edition, 2023.
3	B. S. Grewal	Numerical Methods in Engineering & Science with programs in C, C++and MATLAB", Khanna Publishers, 10th Edition, 2015.

REFERENCE BOOKS		
1	John H. Mathews & Kurtis D. Frank	Numerical Methods Using MATLAB, PHI Publications, 4th Edition, 2005.
2	Won Young Yang, Wenwu Cao, Tae Sang Chung, John Morris	Applied Numerical Methods Using MATLAB, WILEY Interscience, 2005.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Explain and measure errors in numerical computations
CO2	Test for consistency and solve a system of linear equations.
CO3	Construct a function which closely fits given n- n-points of an unknown function.
CO4	Apply the basic concepts to solve problems related to numerical integration and differentiation.
CO5	Use appropriate numerical methods to study phenomena modelled as partial differential equations.

Course Articulation Matrix

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

VLSI PROCESS TECHNOLOGY

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S3EC07	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the environment for IC fabrication technology and production of Silicon wafer and oxidation process.
2.	Understand the deposition of thin film using CVD and PVD techniques
3.	Learn incorporation of impurity in the thin film and etching process.
4.	Understand the lithography techniques and various characterization tools for analysing the properties of thin film.
5.	Learn VLSI process integration and packaging types.

UNIT I

Introduction: Electronic-Grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Process Considerations. Environment for VLSI technology: clean room and safety requirements, Wafer cleaning process.

Epitaxy: Introduction, Vapour-Phase Epitaxy, Molecular Beam Epitaxy.

Oxidation: Wet and dry oxidation process.

9 Hours

UNIT II

Chemical Vapour deposition techniques: CVD techniques for deposition of materials: PECVD, APCVD, and LPCVD.

Metallization: Metallization Applications, Metallization Choices, Physical Vapor Deposition (evaporation and sputtering techniques).

9 Hours

UNIT III
Impurity incorporation: Models of diffusion in Solids, Fick's laws for Diffusion, measurement Techniques. **Ion implantation:** Introduction, Implantation Equipment, Annealing. **Reactive Plasma Etching:** Introduction, Plasma Anisotropic Etch Mechanisms, Other Properties of Etch Processes, Reactive Plasma-Etching Techniques and Equipment.
8 Hours

UNIT IV
Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. **Thin film Characterization:** Overview of thin film characterization, Imaging techniques: Scanning electron microscopy (SEM), AFM, Structural properties: X-ray diffraction (XRD), Electrical properties: Resistance/resistivity – four point probe, Vander Pauw, Mechanical properties: Stress-curvature measurements.
8 Hours

UNIT V
VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication. **Packaging of VLSI Devices:** Introduction, Package Types, Packaging Design Considerations.
8 Hours

TEXT BOOKS		
1	S. M. Sze	VLSI Technology, McGraw-Hill, 2nd Edition, 2017.
2	S.K. Ghandhi	VLSI Fabrication Principles, John Wiley Inc., New York, 2nd Edition, 2008.

REFERENCE BOOKS		
1	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2010.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyze the crystal growth process and select suitable oxide growth techniques employed in IC fabrications.
CO2	Analyze and select appropriate chemical vapour deposition method to deposit different thin films and metallization process for IC fabrications.
CO3	Apply and select appropriate impurity incorporation method, annealing techniques used in IC fabrications.
CO4	Apply the various lithography techniques used in IC fabrications. Identify, select and analyse the various characterization techniques.
CO5	Apply various IC fabrication process sequence and special considerations. Select an appropriate package type and discuss design considerations of VLSI devices.

Course Articulation Matrix

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

SOCIAL CONNECT & RESPONSIBILITY

Contact Hours/ Week:	0+0+2	Credits:	1
Total Lecture Hours:	28	CIE Marks:	100
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.

7 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.
5 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.

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

A total of 26 hrs engagement per semester for this course in 3rd semester of the B.E. program. The students will be divided into 1 group of 60 each. Each group will be handled by one faculty mentor.

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 ENHANCEMENT COURSES

ELECTRONIC SYSTEM DESIGN

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S3ECA01	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.	Understand the process of digital system design and implement using Virtual Lab.
3.	Design an electronic system and implement using hardware.

List of experiments (LT-SPICE/Virtual Lab/Hardware implementation)

1. Design a 4:1 multiplexer, develop verilog code and implement it on FPGA.
2. Design a 4 bit synchronous up/down counter, develop verilog code and implement it on FPGA.
3. Develop verilog code for 2:4 decoder and implement it on FPGA.
4. Develop verilog code for i) D-F/F ii) T-F/F and implement the same on FPGA
5. Industrial Control (Temperature and Pressure) & Fuel Level Indicator (Virtual Lab)
6. Seat Belt Warning System & Water Level Indicator (Virtual Lab)
7. Electronic Clock & Automobile Alarm (Virtual Lab)
8. Staircase Light Control system (Virtual Lab)
9. Clippers and Clampers (using MokuGo Kit)

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	Analyse and design an electronic system and implement using virtual lab.
CO2	Analyse and design an electronic system and implement using hardware.
CO3	Develop Verilog code for a digital system and implement using FPGA.

Course Articulation Matrix

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	3	2			2				1			2	1
	CO2	3	2			2				1			2	1
	CO3	3	2			2				1			2	1

MATLAB FOR EC ENGINEERING

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S3ECA02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as MATLAB.
2.	Solve, Simulate and Analyze basic Electrical and Electronics Circuits and Applications by writing Ohm's law, KCL and KVL Mathematical Equations and Programs.
3.	Develop hands-on working experience with reference to Solve, Simulate and Analyze Electrical & Electronics Circuits using MATLAB.

List of Experiments

1. Gain versus Frequency of an RC Amplifier
2. A 3-bit A/D Converter
3. Nodal Voltage Circuit with Dependent Sources
4. Power Calculations of One-port Network
5. Magnitude and Phase Response of an RLC circuit
6. h-parameters of Bipolar Junction Transistor
7. Amplitude and Phase Spectrum of Full-wave Rectifier Waveform
8. Power Spectral Density of a Noisy Signal
9. Full-wave Rectifier – Ripple Voltage, DC Output Voltage, Discharge Time and Period of Ripple
10. Frequency Response of a Common Emitter Amplifier

TEXT BOOKS:		
1	Rudra Pratap	Getting started with MATLAB, Oxford University Press, 2019.
2	S. K. Bhattacharya	Basic Electrical and Electronics Engineering, Pearson Education India, 2012 Edition.

REFERENCE BOOKS:		
1	Rajkumar Bansal	MATLAB and its Applications in Engineering, Pearson Publishers, ISBN-10: 8131716813, 2009.
2	Dr. N. K. Jain	A Text Book of Practicals in Electrical Engineering, Dhanpat Rai Publishing Company, 2009.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the main features and importance of the MATLAB mathematical programming environment.
CO2	Apply working knowledge of MATLAB to simulate and solve Electrical, Electronic circuits and Applications.
CO3	Solve, simulate and analyze various DC circuits.
CO4	Solve, simulate and analyze various AC circuits.
CO5	Solve, simulate and analyze various Analog Electronics circuits.

Course Articulation Matrix

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

SIGNAL PROCESSING WITH R

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S3ECA04	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Simulate discrete time signals and verification of sampling theorem.
2.	Compute the DFT for a discrete signal and verification of its properties using R.
3.	Find solution to the difference equations and computation of convolution and correlation along with the verification of properties.
4.	Compute and display the filtering operations and compare with the theoretical values.

List of Experiments

1. Verification of sampling theorem (use interpolation function).
2. Determine the Impulse response of first order and second order system.
3. Linear and circular convolution of two given sequences, Commutative, distributive and associative property of convolution.
4. Overlap Save Block Convolution and Overlap Add Block Convolution
5. Auto and cross correlation of two sequences and verification of their properties.
6. Solving a given difference equation.
7. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
8. Verification of DFT properties (like Linearity and Parseval's theorem, etc.)
9. Design and implementation of Low pass and High pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering.

10. Design and implementation of a digital IIR filter (Low pass and High pass) to meet given specifications and test with an audio file. Plot the spectrum of audio signal before and after filtering.

TEXT BOOK:		
1	Tilman M. Davies	The Book of R, A First Course in Programming and Statistics, No Starch Press, 2016.

REFERENCE BOOKS:		
1	Garrett Grolemund	Hands-On Programming with R, O'Reilly Media, 2014.
2	John G. Proakis, Dimitris G. Manolakis	Digital Signal Processing, Pearson, 4th edition, 2007.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyze the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
CO2	Model the discrete time signals and systems and verify its properties and results.
CO3	Implement signal processing algorithms using R.
CO4	Realize the digital filters using a simulation tool and analyze the response of the filter for an audio signal.
CO5	Write programs using R to illustrate DSP concepts.

Course Articulation Matrix

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

ELECTRIC CIRCUIT ANALYSIS

Contact Hours/ Week:	: 0+0+2	Credits:	1
Total Practical Hours:	: 28	CIE Marks:	50
Sub. Code:	: S3ECA05	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 (LT-Spice/Virtual Lab)

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

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2				1			2	1
	CO2	3	2			2				1			2	1

IV SEM SYLLABUS

COMMUNICATION SYSTEMS-I

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	: S4EC01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the basic representation of pass band signals.
2.	Understand analog modulation and demodulation techniques.
3.	Understand the sampling process and pulse modulation techniques.
4.	Understand different digital modulation and demodulation techniques and its applications.

UNIT I

Representation of Baseband and Bandpass signals: Analog vs Digital Communication, Review of Fourier transform, Energy spectral density and bandwidth, Baseband and Passband Signals, The structure of a passband signal: Time domain relationships, Frequency domain relationships, Complex baseband equivalent of passband filtering, General comments on complex baseband.

9 Hours

UNIT II

Analog modulation and demodulation: Double sideband suppressed carrier modulation, Conventional AM, Single-sideband modulation, Vestigial-sideband modulation Quadrature amplitude modulation, Concept synthesis for AM. Frequency modulation, Limiter discriminator

demodulation, FM spectrum, The Superheterodyne receiver, The phase locked loop, PLL applications, FM radio.
9 Hours

Sampling and Quantization: Sampling Theorem, Time division multiplexing, Digital Pulse modulation: Pulse amplitude modulation, Pulse Code Modulation, Pulse Width Modulation, Quantization noise, Companding and coding techniques, Robust quantization, Delta modulation.
8 Hours

UNIT IV
Digital Modulation Techniques: Signal Constellations, Bandwidth occupancy, Power Spectral Density, PSD of a linearly modulated signal. Design of band limited channels, Nyquist criterion for ISI avoidance, Bandwidth efficiency, power bandwidth trade-offs.
8 Hours

UNIT V
Optimum Demodulation: Hypothesis testing: Error probabilities, ML and MAP decision rules. Geometry of the ML decision rule. Performance analysis of ML reception: The geometry of errors, Performance with binary signalling and M-ary signalling.
8 Hours

TEXT BOOKS		
1	Upamanyu Madhow	Introduction to Communication Systems, Cambridge University Press, 2014.
2	Simon Haykin	Digital Communications, John Wiley, 2012.

REFERENCE BOOKS		
1	K Sam Shanmugam	Digital and Analog Communication Systems, John Wiley, 2011.

E-RESOURCES	
1	https://sites.google.com/iittp.ac.in/naveenkp/teaching/lectures

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Develop the complex baseband representation of passband signals.
CO2	Analyse analog modulation and demodulation techniques.
CO3	Compute digital equivalent of the analog signal and analyse with different sampling rates.
CO4	Evaluate digital modulation techniques using different parameters.
CO5	Compare ML and MAP decision techniques with performance analysis.

Course Articulation Matrix

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

CONTROL SYSTEMS

Contact Hours/ Week:	3+0+2	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	28	SEE Marks:	50
Sub. Code:	S4ECI02		

Course objectives:
This course will enable students to:

1.	Develop mathematical modeling of control systems, and determine its transfer function. Reduce the given electrical system using signal flow graphs technique and obtain the transfer function.
2.	Study the transient and steady state response of the system with different input signals, concept of different types of feedback controllers to control system.
3.	Stability analysis of a given system using Routh-Hurwitz criterion and Root locus techniques.
4.	Stability analysis of a given system using polar Plots and Nyquist plots and obtain Gain margin & phase margins.
5.	Stability analysis using Bode Plots, obtain -Gain and phase margin and analyze the Lead, Lag and lag-lead compensators.

UNIT I

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of Electrical systems and transfer function. **Signal flow graphs**: signal Flow graph, Mason's gain formula applicable to Electrical and Electronics systems.

8 Hours

UNIT II

Time Response Analysis: Unit step response of first and second order linear-time-invariant systems (Qualitative), time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Feedback Controllers: Analysis and design of feedback controllers based on time response applicable to systems.

8 Hours

UNIT III

Concept of Stability: 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.

9 Hours

UNIT IV

Stability Analysis using Polar & Nyquist Plots: Polar plots, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin.

8 Hours

UNIT V

Frequency-response analysis: Bode plots, Closed-loop frequency response (Transfer function) from Bode Plot, and Stability analysis of systems.

System Compensation: Analysis of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to systems.

9 Hours

TEXT BOOKS

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

REFERENCE BOOKS		
1	Ogata K.	Modern Control Engineering. Pearson Education Asia/PHI., 4th Edition, 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 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 time response 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 by polar plot and Nyquist plot techniques.
CO5	Analyze and interpret the stability using Bode's Plot Technique. Analyze the lead, lag and lead-lag compensators for linear-time-invariant systems.

Integrated Lab

Sl. No.	**Experiments (Using LT-Spice and 20-Sim):**
1.	Determine the transfer function of the electrical system and plot the location of poles and zeros.
2.	Determine open-loop and closed- loop poles and zeros of the system for given G(s) and H(s).
3.	Design electrical circuit for given values of poles and zeros.
4.	Analyze 1st and 2nd order system response for unit delta and unit step input

5.	Analyze 2nd order under damped system(series RLC electrical circuit) for unit step input.
6.	Design a P, PI, PID controller to study its transient and steady state Behavior
7.	Analyze stability of a system using root locus.
8.	To study effect of addition of poles and zeros on root locus and stability
9.	Analyze stability of a system using Bode plot.
10.	State space analysis and lag-lead compensation using Bode plots.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
	CO2	3	2	-	-	2	-	-	-	-	-	-	2	2
	CO3	3	2	-	-	2	-	-	-	-	-	-	2	2
	CO4	3	2	-	-	2	-	-	-	-	-	-	2	2
	CO5	3	2	-	-	2	-	-	-	-	-	-	2	2

ARM MICROCONTROLLER

Contact Hours/ Week:	3+0+2	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	28	SEE Marks:	50
Sub. Code:	S4ECI07		

Course objectives:

This course will enable students to:

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

UNIT I

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

8 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.

9 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.
9 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, TMH, 2nd Edition, 2017.
2	ARM7TDMI	Datasheet
3	UM10139 LPC214x User manual	

E-resources:	
1	https://archive.nptel.ac.in/courses/117/106/117106111/
2	https://archive.nptel.ac.in/courses/106/105/106105193/
3	https://onlinecourses.nptel.ac.in/noc22_cs93/preview

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

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	3	2			1							2	
	CO2	3	2										1	
	CO3	3	2			1							1	1
	CO4	3	2										1	
	CO5	2	1										1	
	CO6	3	2	1		1				1		1	1	1

Integrated Lab Using Embedded C and/ or LPC 2148

List of Experiments:

1. Develop a program for addition/ subtraction/ multiplication of numbers
2. Develop a program for sorting of No's.
3. Develop a program for Flashing / rolling LED
4. Develop a program to turn on LED whenever a push button is pressed and sound the alarm
5. Develop a program to convert given analog voltage to digital value
6. Develop a program to generate a square wave on a GPIO pin when a key is pressed and stop whenever key is released
7. Develop a program to interface a DC motor and rotate it in clockwise and anticlockwise direction.
8. Develop a program to interface LCD unit and display a message.
9. Develop a program to generate square wave / sine wave/ triangular/Staircase wave using DAC of LPC2148
10. Develop a program to display the key pressed from keypad over a 16X2 LCD using LPC2148

COMMUNICATION SYSTEMS-1 LAB

Contact Hours/ Week:	: 0+0+2	Credits:	1
Total Practical Hours:	: 28	CIE Marks:	50
Sub. Code:	: S4ECL01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the process of modulation and demodulation in communication systems.
2.	Understand the sampling and quantization process.

I. Rig Up Experiments:

1. Design and demonstrate the generation and demodulation of standard amplitude modulated signal.
2. Design and demonstrate frequency modulation system.
3. Design and demonstrate pulse amplitude modulation and demodulation
4. Design and demonstrate pulse width modulation.
5. Verify sampling theorem using Flat Top Samples
6. Design and demonstrate generation and detection of Binary Amplitude Shift Keying
7. Design and demonstrate generation of Binary Phase Shift Keying

II. Simulation Experiments using Matlab/Scilab/Octave/SDR:

1. FM transmitter and receiver
2. Mixer
3. Verification of Sampling theorem
4. Simulation of Pulse code modulation system
5. Delta modulator and demodulator

6. Eye diagram plot
7. Generation of ASK, PSK and FSK

III. Study Experiments:

1. Design a ring modulator to generate double sideband suppressed carrier amplitude modulated signal.
2. Design and demonstrate pulse position modulation and demodulation
3. Non uniform quantization using A-law and – μ-law.

UNIT IV

IV. Open Ended Experiments:

1. Develop AM radio using super heterodyne receiver.
2. Develop FM stereo transmitter and receiver.
3. Develop AM, DSBSC, SSBSC and VSBSC transmitters and compare the power requirements.
4. Design FM demodulator using phase locked loop.
5. Design frequency synthesizer using phase locked loop.

Course Outcomes:

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

CO1	Demonstrate generation and detection of analog modulated signals.
CO2	Design and demonstrate pulse modulation systems.
CO3	Analyze the effect of sampling frequency for signal discretization.
CO4	Perform signal quantization.

Course Articulation Matrix

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

ENGINEERING SCIENCE COURSES
FIELDS, LINES AND WAVES

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4EC03	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the Electrostatic field, Magneto-static field & Time-varying fields.
2.	Learn boundary conditions & boundary value problems.
3.	Understand Maxwell's equations.
4.	Acquire knowledge of dielectrics and its properties.
5.	Learn the Electromagnetic waves traveling through free space, lossy dielectric, lossless dielectric and conductors.

UNIT I

Introduction: Review of Coordinate systems; Coulomb's Law and Electric field intensity**,** Electric fields due to continuous charge distributions: Line and Sheet (No derivations), Electric Flux Density, Gauss's Law, Gauss Divergence Theorem (No Proof), Problems.

8 Hours

UNIT II

Energy and potential: Electric potential (point charges), Work done in an electric field, Potential difference, Conservative field, relation between E & V (Qualitative analysis: No derivations).

Conductors and Dielectrics: Current and current density (Define),

conductor & dielectric properties, continuity equation (No derivation), boundary conditions (Dielectric-Dielectric only, No derivation).
8 Hours

UNIT III
Poisson's and Laplace's equations: Poisson's and Laplace's equations, Uniqueness theorem (No proof), Examples of the solutions of Laplace's equation in one dimension (Examples on capacitors –Parallel plate, Spherical & Cylindrical.
8 Hours

UNIT IV
Time varying fields & Maxwell's equations: Faraday's law, Transformer & Motional EMFs, Displacement current, Modified Ampere's law, Time- varying Maxwell's equations in point & integral forms, Time harmonic Maxwell's equations.
9 Hours
UNIT V
Electromagnetic waves and Transmission Lines: Uniform plane wave (UPW) - properties and transverse nature, loss tangent, skin-effect, Poynting vector. Transmission line equivalent lumped element circuit and parameters, concept of lumped elements and distributed elements, Line equations (No Derivation), Lossless line, Distortion less line, Input impedance (qualitative analysis only; no derivation), reflection coefficient, transmission coefficient, SWR, standing wave patterns. Applications of fields, lines and waves, polarization.
9 Hours

TEXT BOOKS		
1	Matthew N. O. Sadiku and S.V. Kulkarni	Principles of Electromagnetics, Oxford University Press India, 6th Edition, 2019.

REFERENCE BOOKS		
1	W.H. Hayt. J.A. Buck & M Jaleel Akhtar	Engineering Electromagnetics, Tata McGraw – Hill, 9th Edition, 2020.
2	Joseph Edminster	Electromagnetics, Schaum's Outline Series, Tata McGraw-Hill, 4th Edition, 2013.
3	Edward C Jordan and Keith G Balmain	Electromagnetic Waves and Radiating Systems, Prentice-Hall of India, 2nd Edition, 2002.

E-RESOURCES	
1	https://www.youtube.com/watch?v=ZX1JzPdIk2A&list=PLuv3GM6-gsE3- hVNaw-YEb7EeY5XVPZdz&index=14
2	https://www.youtube.com/watch?v=mm1Qgq1WKC0&list=PLuv3GM6- gsE3-hVNaw-YEb7EeY5XVPZdz&index=23
3	https://www.youtube.com/watch?v=xxIb9Qv6t7E&list=PLuv3GM6-gsE3- hVNaw-YEb7EeY5XVPZdz&index=47

Course Outcomes:

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

CO1	Analyze the relationship between electric field and potential.
CO2	Apply and analyze boundary conditions for Electromagnetic field and analyze the boundary value problems using Poisson's and Laplace's Equations.
CO3	Identify, apply Maxwell's equations for analysis of static and time varying fields.

CO4	Analyze the wave propagation in different medium based on its parameters.
CO5	Demonstrate the performance of transmission lines using Smith Chart.

Course Articulation Matrix

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

INDUSTRIAL ELECTRONICS

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4EC04	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the theory and applications of power electronics systems.
2.	Understand the characteristics of different power electronics switches and different types of gate drive control and isolation of gate and base drive techniques.
3.	Design of power electronics circuits such as AC/DC for single phase and three power converter circuits and their applications.
4.	Design of power electronics circuits such as DC/DC for single phase and three phase power converter circuits and their applications.
5.	Design of power electronics circuits such as DC/DC for single phase and three phase power converter circuits and their applications.

UNIT I

Power electronic system overview: Introduction, power electronic systems, power semiconductor devices, power electronic converter, power electronic applications, control characteristics.

Thyristor principles and characteristics: Principle of operation of SCR, static characteristics of SCR, two transistor model of SCR, thyristor construction, gate characteristics, turn on methods of thyristors, dynamic turn on and turn off characteristics, turn off methods, gate triggering circuits, firing of thyristors, UJT triggering, PUT triggering circuits, series and parallel operation.

9 Hours

UNIT II
Power Semiconductor devices: Introduction, power transistors, bipolar junction transistors, power MOSFETs, Triac, Diac, LASCR, turn on and turn off characteristics.
8 Hours

UNIT III
Phase controlled converters: Controlled techniques, single phase half wave controlled rectifier, single phase full wave controlled rectifier (two quadrant converters), single phase half controlled bridge rectifier, three phase controlled converters, three phase controlled converters, three phase fully controlled bridge converters and three phase half controlled bridge converters, principles of dual converter with and without circulating currents.
9 Hours

UNIT IV
Choppers: Introduction, classification, basic chopper operation, control strategies, chopper configuration, Jones and Morgan chopper, applications on power control.
8 Hours
UNIT V
Inverters: Introduction, principle of operation, performance parameters of inverters, single phase inverters, three phase inverters 120° and 180° conduction mode, series inverter, parallel inverter, self-commutated inverters.
8 Hours

TEXT BOOKS		
1	Muhammad H.Rashid	Power Electronics, Pearson Ed., 4th Edition, 2017.
2	M.D. Singh & K.B. Khanchandani	Power Electronics, TMH, 4th Edition, 2017.

REFERENCE BOOKS		
1	P.C. Sen	Power Electronics, TMH, 4th Edition, 2017.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyze the switching characteristics of IGBT, MOSFET and thyristor.
CO2	Analyze the turn on and turn off characteristics of thyristor and the different types of controlled rectifier circuits.
CO3	Analyse the operation of single phase and three phase power converters.
CO4	Analyse the operation of DC-DC choppers.
CO5	Analyze operation of DC/AC for single phase and three phase power converter.

Course Articulation Matrix

		PO's											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	2	1										1	
	CO2	2	2	1		1			2	1		1	1	
	CO3	2	2										1	
	CO4	2	2	1									1	
	CO5	2	2	1		1			2	1		1	1	

SOLID STATE DEVICES AND TECHNOLOGY

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4EC05	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the properties of Silicon semiconductors.
2.	Understand the overview of physical chemical techniques for thin film deposition.
3.	Understand working principles of diodes, transistor and MOSFETs.
4.	Describe various aspects of electronic devices and circuits.

UNIT I

Fabrication Technology: Introduction, Why Si, the purity of Si, Si from sand, Czochralski growing process: melt and the dopant, seed crystal, ingot slicing and wafer preparation, Fabrication Process: thermal oxidation, etching techniques, diffusion, expressions for the diffusion of dopant concentration, photomask generation, photolithography, epitaxial growth, metallization, interconnections and ohmic contacts, fabrication of resistors and capacitors in IC's.

9 Hours

UNIT II

PN Junction Diode: Introduction, Space charge region: Formation of region, barrier voltage and energy bands, drift and diffusion currents, analytical relations of equilibrium: electrostatics of the space charge region, constancy of the fermi level, built-in voltage in terms of fermi potential, built-in voltage in terms of doping densities, electric field and potential in the space charge region, width of the space charge region, conditions in the

diode with voltage applied, current in diode: motion of carriers with bias applied, conditions with forward bias, conditions with reverse bias.

9 Hours

UNIT III

Bipolar Junction Transistors: Introduction, structure and basic operation, Fabrication of the bipolar integrated circuit transistor, terminology and symbols, modes of operation, circuit arrangements, transistor currents in the active region: emitter current, collector current, base current, BJT as a current amplifier: approximations to base current, base current as the control current, fixing I_B or V_{BE}, transistor parameters, graphical characteristics and modes of operation, Numerical problems.

8 Hours

UNIT IV

Metal Semiconductor Junctions and Devices: Introduction, energy band diagrams of metal and n-semiconductor before and after contact-Schottky barrier, Schottky barrier diode: rectifying metal-n semiconductor contact, properties of depletion region, rectifying metal-p semiconductor junction.

8 Hours

UNIT V

Metal Oxide Silicon Systems: Introduction, energy band diagrams, band bending and the effect of bias voltages.

Metal Oxide Semiconductors Field Effect Transistor: Introduction, construction and basic operation, isolation process, Poly silicon, deposition of silicon dioxide, silicon nitride and poly silicon, fabrication of n-type MOSFET (nMOS) on an IC chip, regions of operation, types of MOSFETs, comparison with BJT.

8 Hours

TEXT BOOKS		
1	Kanaan Kano	Semiconductor Devices. PHI, 2009.
2	S M Sze	Semiconductor Devices-Physics & Technology, John Wiley, 3rd Edition, 2011.

REFERENCE BOOKS		
1	Donald A Neamen	Semiconductor Physics and Devices- Basic Principles, 4th Edition, 2017.
2	M K Achutan and K N Bhat	Fundamentals of Semiconductor Devices, TMH, 2017.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze materials used in electronic engineering.
CO2	Analyze different techniques used for fabrication of devices.
CO3	Analyze the characteristics of various electronic devices like diode, transistor and MOSFET.
CO4	Design devices for smart systems.
CO5	Analyze reliability of Si and related devices

Course Articulation Matrix

		PO's											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	1	2										2	1
	CO2	2		2									2	1
	CO3		2	2									2	1
	CO4		2	2									2	1
	CO5	2	1										2	1

DATA STRUCTURES WITH C

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S4EC06	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
2.	Use linear and non-linear data structures like stacks, queues, linked list.

UNIT I

Introduction to Data Structures: Definition, Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear.

Arrays*:* Definition, Representation, Single dimension, Two-dimensional, Multi-dimensional Arrays, Passing arrays to functions, passing strings to functions;

Structures: Declaring and using structure types; Introduction to Pointers.

9 Hours

UNIT II

Array and String as Data Structure: Operations - Insert, Delete, Search, Sort, String Definition, Representation, Operations – Insert, Delete, Concatenate, Comparing, Substring.

8 Hours

UNIT III
Stacks: Stack Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion; Recursion - Factorial, Fibonacci Sequence.
8 Hours

UNIT IV
Queues*:* Definition, Representation, Operations, Queue Variants: Circular Queue, Priority Queue, Double Ended Queue, Applications of Queues.
8 Hours

UNIT V
Introduction to Linked Lists and Trees: Inserting and removing nodes from a list, Linked implementations of stacks, Example of list operations such as insert and delete an element before a key element. **Trees:** Definitions, Terminologies, Array and linked Representation of Binary Trees, Types of Binary trees, Complete, perfect, Strictly, Skewed, Balanced.
9 Hours

TEXT BOOKS		
1	E Balaguruswamy	Data Structures Using C, McGraw Hill Education, 1st Edition, 2017.

REFERENCE BOOKS		
1	Yedidyah Langsam, Moshe J. Augenstein and Aaron M Tenenbau	Data Structures Using C and C++, Pearson Education Asia. 2nd Edition, 2018.

2	Vinu V. Das	Principles of Data Structures using C & C++, New Age International, 2006.

E-RESOURCES	
1	https://nptel.ac.in/courses/106102064
2	https://www.youtube.com/watch?v=4OGMB4Fhh50&list=PLBlnK6fEyqRhX6r2uhhlubuF5QextdCSM

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Analyse the performance of Stack, Queue, Lists, Trees, Hashing, Searching and Sorting techniques.
CO2	Implement all the applications of Data structures in a high-level language.
CO3	Analyse the performance of stacks for solving complex problems.
CO4	Apply the concept of Queues for data storage in searching and sorting.
CO5	Design and apply appropriate data structures for solving complex problems.

Course Articulation Matrix

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

BIOLOGY FOR ENGINEERS

Contact Hours/ Week:	3+0+0	Credits:	3
Total Lecture Hours:	42	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.

9 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).

9 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., 1st 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	Credits:	1
Total Lecture Hours:	14	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.

3 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 COURSES

COMMUNICATION APPLICATIONS USING PYTHON

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S4ECA01	SEE Marks:	50

Prerequisites: Basic Knowledge of Python Programming, Signals and systems, Communication systems-1.

Course objectives:

This course will enable students to:

1.	Practice various computing strategies for Python-based solutions to real world problems.
2.	Use Python data structures-lists, tuples, dictionaries.

List of experiments:

1. Write a Python program to find rank, determinant and trace of an array, eigenvalues of matrices, matrix and vector products (dot, inner, outer, product), matrix exponentiation, solve a linear matrix equation or system of linear scalar equations.
2. Write a Python program to synthesize a compound signal by creating SinSignal and CosSignal objects and adding them up. Compute its Spectrum and plot it.
3. Write a Python program to perform convolution of a signal with a series of impulses.
4. Write a Python program to generate noise, plot its spectrum/normal probability plot and categorize based on the distribution.
5. Write a Python program to plot auto correlation of different kind of noises.

6. Write a Python program to calculate the pitch of periodic signal.
7. Write a Python program to plot (i) Bar plots (ii) Histograms (iii) Line plots (iv) Scatter plots using Pandas.
   b) Demonstrate use of groupby() method.
   c) Demonstrate pandas Merging, Joining and Concatenating
   d) Create data frames from csv and excel files.
8. Write a Python program to create a white image using NumPy b) Convert a NumPy array to an image and Convert images to NumPy array c) Perform Sorting, Searching and Counting using Numpy methods. d) Demonstrate the use of the reshape () method.
9. Write a Python program to analyze the implications of sampling theorem at variable sampling rates for a sine wave input signal.
10. Write a Python program to transmit / receive data through cloud using socket programming (Server-Client model).

Course Outcomes:

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

CO1	Develop algorithms to perform signal and image processing applications using Python.
CO2	Develop algorithms to compute various characteristics of a noisy Signal.
CO3	Develop applications related to data analytics.
CO4	Analyze signal spectrum in frequency domain.
CO5	Build data transmission using socket programming in python.

Course Articulation Matrix

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

INDUSTRIAL IOT

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S4ECA02	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Develop the skill of usage of modern tools to interface sensors and actuators.
2.	Design and test uploading and retrieval of sensor data to and from cloud database

List of experiments:

1. Study the fundamental of IOT software and components.
2. Familiarization with Arduino/Raspberry Pi and perform necessary software.
3. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to TURN on LED for one second after every five second.
4. To turn on LEDs when push button is pressed and also to alarm the sound using buzzer.
5. Program to interface LDR and to sound the buzzer.
6. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
7. Program to interface LCD unit and to display messages.
8. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.

9. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
10. To interface OLED/ LCD with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
11. Program to calculate the distance between the object and the ultrasonic sensor using Arduino/Raspberry Pi.
12. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Blue tooth.
13. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON and OFF when "1" of "0" is received from smart phone using Blue tooth.
14. Write a program on Arduino/Raspberry Pi to upload temperature and humidity readings to things speak cloud.
15. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity readings from things speak cloud.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Develop programs using Arduino/Raspberry Pi for interfacing sensors and actuators.
CO2	Develop programs in an IoT/Blue tooth environment to upload and download the sensor data to and from cloud/database.

Course Articulation Matrix

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	CO1	3	2	2		3			2			2		1
	CO2	3	2	2		3			2			2		1

ADVANCED DIGITAL DESIGN USING SYSTEM VERILOG

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S4ECA03	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the usage of modern tools to analyze digital VLSI circuits.
2.	Design and test digital VLSI systems.

List of experiments (using Modelsim/Cadence)

1. Design counting 0s in 10 bit input
2. Design a 6 bit comparator using structural approach
3. Design 5 bit Binary to BCD converter using dataflow
4. Design signed subtraction using dataflow
5. Design a comparator with 4 outputs (gt, aeq, eeq, lt)
6. Design a BCD to excess-3 converter
7. Design a counter for 24 hours format
8. Design mod5-mod7-mod9 sandwich counter
9. Design an elevator for four floor building
10. Design a circuit to detect a name sequence

E-Resources:

1	https://www.youtube.com/watch?v=NCrlyaXMAn8&list
2	https://www.youtube.com/watch?v=y_hEbgWWuQs

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Design and analyse combinational circuits using system Verilog.
CO2	Design and test sequential circuits using system Verilog.

Course Articulation Matrix

		POs											**PSOs**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	3	2			1			2			1	1	1
	CO2	3	2			1			2			1	1	

COMMUNICATION SYSTEMS USING GNU RADIO

Contact Hours/ Week:	0+0+2	Credits:	1
Total Lecture Hours:	28	CIE Marks:	50
Sub. Code:	S4ECA04	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn the usage of GNU radio to analyze communication systems.
2.	Understand the process of communication system design and implementation using GNU Radio.

List of experiments (using GNU Radio)

1. Design and demonstrate the generation and demodulation of amplitude modulated signal.
2. Design and demonstrate single sideband modulation and demodulation.
3. Design and demonstrate frequency modulation and demodulation.
4. Design and demonstrate frequency mixer.
5. Design and demonstrate pulse amplitude modulation and demodulation.
6. Design and demonstrate pulse width modulation and demodulation.
7. Design and demonstrate pulse code modulation and demodulation.
8. Design and demonstrate generation and detection of Binary Amplitude Shift Keying.
9. Design and demonstrate generation and detection of Binary Frequency Shift Keying.
10. Design and demonstrate generation and detection of Binary Phase Shift Keying.

Course Outcomes:	
After the completion of this course, students will be able to :	
CO1	Demonstrate analog communication systems.
CO2	Demonstrate PAM, PCM, PWM communication systems.
CO3	Demonstrate digital communication systems.

Course Articulation Matrix

		POs											PSOs	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
COs	**CO1**	2	2			3			2	2			2	2
	CO2	2	2			3			2	2			2	2
	CO3	2	2			3			2	2			2	2

ADVANCED TECHNICAL TRAINING-C++ LAB

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	S4ECA04	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2.	Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3.	Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding.

Topics to be covered:

1. Structure of a 'C' Program
   a. Main Function
   b. Input & Output
   c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements

a. Conditional Statements

- If
- If-else
- Simple
- Nested
- Multiple
- switch

b. Looping Statements
- while
- do-while
- for

6. Arrays
- Single Dimensional
- Two Dimensional
- String as Character Arrays

7. Functions and Recursive Functions
8. Pointers
9. Structures and Unions
10. Enumerations
11. Files

12. Introduction to Data Structures
- Space Complexity
- Time Complexity

13. Classification of data structures
- Linear Data structures
- Non-Linear Data Structures

14. Array Versus Linked List
15. Linked List
- Single Linked List
- Double Linked List
- Circular Linked List

16. Stack
- Push
- Pop

17. Queue
- Enqueue
- Dequeue

18. Searching Techniques
- Linear Search
- Binary Search

19. Sorting Techniques
    - Bubble Sort
    - Insertion Sort
    - Selection Sort
    - Merge Sort
    - Quick Sort

20. Tree
    - Pre-Order
    - In-Order
    - Post-Order

21. Graph
    - DFS
    - BFS

22. Introduction to Object Oriented Programming and C++
23. Difference between C and C++
24. C++ Programming Structures and Input/output Functions
25. OOPS Concepts
    - Class and Object
    - Abstraction
    - Encapsulation
    - Inheritance
    - Polymorphism

26. Implementation of the OOPS Concepts

Course Outcomes:

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

CO1	Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.
CO2	Implement different data structures like Stacks and Queues using static and dynamic memory allocation techniques.
CO3	Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	2	2			3			2	2			2	2
	CO2	2	2			3			2	2			2	2
	CO3	2	2			3			2	2			2	2