SYLLABUS
FOR
III and IV semester B.E.

2024 - 2025

Sree Siddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous Institution affiliated to V.T.U., Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade and ISO 9001:2015 Certified)

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Siddaganga Institute of Technology, Tumkur-572103
Department of Electronics & Instrumentation Engineering

Vision of the Institute

To develop thoughtful and creative young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute

1. To continuously strive for the total development of students by educating them in state-of-the-art-technologies and managerial competencies providing best in class learning experience with emphasis on skills, values and learning outcomes and helping them imbibe professional ethics and societal commitment.
2. To create a research ambience that promotes interdisciplinary research catering to the needs of industry and society.
3. To collaborate with premier academic and research institutions and industries to strengthen multidisciplinary education, applied research, innovation, entrepreneurship and consulting ecosystems.

Quality Policy

Siddaganga Institute of Technology is Committed to:

1. Impart Quality Education by establishing effective learning - teaching - learning processes to produce competent engineers and managers with high professional ethics and societal responsibility.
2. Create congenial environment and provide state-of the-art infrastructure.
3. Continually improve the effectiveness of the Quality Management System.
4. Satisfy applicable requirements.

Vision of the Department

To become a premier Electronics and Instrumentation Engineering Department by imparting quality education in the fields of electronics, instrumentation and cutting edge technologies developing competence to meet industrial norms and to pursue research and innovation contributing to socioeconomic development.

Mission of the Department

1. Develop competent professionals by offering industry aligned curriculum in Electronics, Instrumentation and VLSI and embedded systems along with an exposure to cutting edge technologies by providing best in class learning, promoting interdisciplinary research and innovation catering to industrial and societal needs.
2. Encourage and prepare students for higher studies to promote lifelong learning.
3. Imbibe professional ethics and skills in students to provide engineering service to the society.
4. Collaborate with industries to inculcate industry readiness, creativity, managerial competence, experiential learning and entrepreneurship skills.

Program Educational Objectives (PEOs)

Graduates of the Electronics and Instrumentation Programme

PEO 1: Contribute effectively in industry and excel in higher education by applying the knowledge of Science, Technology, Engineering and Math (STEM) principles.

PEO 2: Engage in lifelong learning by adapting emerging technologies, and excel in research pursuits and entrepreneur to meet the global challenges.

PEO 3: Exhibit professional skills, communication skills, teamwork and leadership qualities imbibing ethical values in their profession for the benefit of society.

Programme Outcomes (PO):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

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.

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

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

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.

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

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.

Programme specific Outcomes (PSO):

Student will be able to

PSO1: Apply the technical knowledge of measurement techniques, instrumentation, control, communications and the state - of - the art technologies in process, healthcare and related domains.

PSO2: Apply the knowledge of Signal Processing, Electronic Circuits and Programming Skills to design embedded systems for real time applications.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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B.E. in Electronics & Instrumentation Engineering

SCHEME OF TEACHING AND EXAMINATION FOR THE AY 2024-25 NEP2

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hours per semester				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	SDA/SSC/TW	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC	S3EI01	Mathematical tools for signal processing	EIE	28	28	0	34	3	50	50	100	3
2.	IPCC	S3CESI1	Digital Electronic Circuits with Verilog	EIE	42	0	28	50	3	50	50	100	4
3.	IPCC	S3EII02	Network Analysis	EIE	42	0	28	50	3	50	50	100	4
4.	PCC	S3CES02	Analog Electronic Circuits	EIE	42	0	0	48	3	50	50	100	3
5.	PCCL	S3EIL01	Analog Electronic Circuits Lab	EIE	0	0	28	2	3	50	50	100	1
6.	ESC	ESC	ESC/ETC/PLC	EIE	42	0	0	48	3	50	50	100	3
7.	UHV	SHS01	Social Connect and Responsibilities **(Board: ME/CH)**	ME	0	0	28	2	-	100	-	100	1
8.	AEC / SEC	AEC	Ability Enhancement course/ Skill Enhancement Course – III	EIE	If offered as Theory Course: 14	0	0	16	3	50	50	100	1
					If offered as Integrated Course: 0	0	28	2					
9.	MC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	-	-	100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
			Total		**210**	**28**	**168**	**252**	**21**	**550**	**350**	**900**	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: PCC: Professional Core Course, **IPCC:** Integrated Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** 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, **SSC:** Self Study Component, **TW:**Term Work, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Offered by the Department)			
S3EIESC01	Characteristics and Error Analysis in Instrumentation System	S3EIESC02	Analog and Digital Communication
S3EIESC03	Biomedical Instrumentation	S3EIESC04	VLSI Process Technology
Ability Enhancement Course – III (Offered by the Department)			
S3EIA01	Circuit Simulation using SPICE	S3EIA02	Virtual Instrumentation
S3EIA04	Programming with Python	S3EIA05	Data Analytics with R Programming

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B.E. in Electronics & Instrumentation Engineering

SCHEME OF TEACHING AND EXAMINATION FOR THE AY 2024-25 NEP2

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hours per semester				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	SDA/SSC /TW	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC	S4EI01	Transducers and Measurements	EIE	42	0	0	48	3	50	50	100	3
2.	IPCC	S4CESI01	Control Systems	EIE	42	0	28	50	3	50	50	100	4
3.	IPCC	S4CESI02	ARM Microcontroller	EIE	42	0	28	50	3	50	50	100	4
4.	PCCL	S4EIL01	Sensors and Measurements Lab	EIE	0	0	28	2	3	50	50	100	1
5.	ESC	ESC	ESC/ETC/PLC	EIE	42	0	0	48	3	50	50	100	3
6.	BSC	S4CCA01	Biology for Engineers	BT	42	0	0	48	3	50	50	100	3
7.	UHV	SHS02	Universal Human Values Course	IEM	14	0	0	16	1	50	50	100	1
8.	AEC / SEC	AEC	Ability Enhancement Course/ Skill Enhancement Course – IV	EIE	If offered as Theory Course				3	50	50	100	1
					14	0	0	16					
					If offered as Integrated Course								
					0	0	28	2					
9.	MC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	0	-	100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
			Total		**238**	**0**	**140**	**280**	**22.5**	**500**	**400**	**900**	**20**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **PCC:** Professional Core Course, **IPCC:** Integrated Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** 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, **SSC:** Self Study Component, **TW:**Term Work, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC)			
S4EIESC01	Computer Organization	S4EIESC02	Power Electronics
S4EIESC03	Foundations of Machine Learning	S4EIESC04	Digital System Design
Ability Enhancement Course – IV			
S4CCA02	Advanced Technical Training -C++ Lab	S4EIA02	COMSOL Multi physics
S4EIA03	Arduino UNO Programming		

3rd Semester

MATHEMATICAL TOOLS FOR SIGNAL PROCESSING

Contact Hours/ Week:	2+2+0 (L+T+P)	Credits:	3
Total Lecture Hours:	28	CIE Marks:	50
Total Tutorial Hours:	28	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S3EI01
Course Type:	Theory (PCC)	Exam Hours:	3

Course objectives:

This course will enable students to:

1.	Represent the signal and understand properties of systems.
2.	Determine the response of a system for arbitrary input
3.	Represent and analyze a signal in frequency domain
4.	Perform frequency domain analysis of LTI systems
5.	Analyze the discrete time LTI systems

UNIT I

Mathematical representation of Signals and Systems: Definition of signals and systems, Mathematical Representation, Classification of signals, Operation on signals, Elementary signals, Systems viewed as interconnection of operations, Properties of systems.

06+06 Hours

UNIT II

Time Domain Representation of LTI Systems: Introduction, Impulse response representation of Discrete LTI systems, Properties of impulse response representation, difference equation representation of LTI systems, Block diagram representation.

06+06 Hours

UNIT III

Fourier representations: Introduction: Orthogonality of complex sinusoids, Introduction to Fourier Series (FS), Fourier Transform (FT) and Discrete Time Fourier Series (DTFS), Discrete Time non periodic signals: DTFT representation, Properties of DTFT.

06+06 Hours

UNIT IV

Applications of Fourier representations: Introduction, Frequency response of LTI system, Solution to difference equations, Fourier transform representation for periodic signals, Sampling of continuous time signals.

05+05 Hours

UNIT V
Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform, Transform analysis of LTI systems, stability & causality, Unilateral Z-transform and its application.
05+05 Hours

TEXT BOOKS		
1	Udaykumar.S	Signals and Systems, Prism books Pvt. Ltd., 7th Edition, 2017,
2	Ganesh Rao and Satish Tunga	Signals and Systems, Cengage India Publisher. 1st Edition, 2017.

REFERENCE BOOKS		
1	Simon Haykin and Barry Van Veen	Signals and Systems, Wiley India, 2nd Edition, 2021.
2	Alan V Oppenheim, Alan S WilIsky and S Hamid Nawab	Signals and Systems, Pearson Education, 2nd Edition, 2015.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of Mathematics to represent, Classify and perform operations on signals and characterize systems.
CO2	Analyze discrete LTI systems in time domain using convolution and solve linear constant coefficient difference equation.
CO3	Analyze continuous and discrete time signals using Fourier series and Fourier transform.
CO4	Analyze the frequency response of LTI Systems using Discrete Time Fourier Transform (DTFT).
CO5	Apply Z-transform to analyze discrete-time signals and systems.

DIGITAL ELECTRONIC CIRCUITS WITH VERILOG

Contact Hours/ Week:	3+0+2 (L+T+P)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3CESI1
Course Type:	Integrated (IPCC)	Exam Hours:	3

Course objectives:
This course will enable students to learn:

1.	The properties of basic gates and simplifications of Boolean expressions using K Maps.
2.	Combinational & sequential circuits with design examples.
3.	Functionality of various memory devices.
4.	Verilog data types with operators and develop Verilog codes for digital blocks in different modelling.

UNIT I

Properties of logic gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.
Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)
Introduction to Verilog HDL: HDL basic concepts, Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for logic circuits using Verilog HDL program.

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.

8 Hours

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

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

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

REFERENCE BOOKS		
1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, 12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st Edition 2015.
3	M Morris Mano & Michael D.Ciletti	Digital Design with an introduction to the Verilog HDL, 6th Edition, Pearson Education ,2018

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

Digital Electronic Circuits Lab (Only for CIE) (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment **List of experiments**	
Part-A Hardware Experiments:	
1.	Realization of Parallel Adder/ Subtractor.
2.	Multiplexer: Adder and Subtractor using MUX.
3.	Use of Decoder chip to drive LED display.
4.	Realization of One bit magnitude comparator.
5.	Design 3-bit up-counter using T-FF.
Part-B Verilog Experiments	
1.	Develop Verilog code for full adder using (i) Dataflow description (ii) Gate-level description
2.	Develop Verilog code for 4:1 MUX using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
3.	Develop Verilog code for 2:4 decoder using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
4.	Develop Verilog code for D FF, JK FF, T FF using behavioral description.
5.	Develop Verilog code for up/down counter

NETWORK ANALYSIS

Contact Hours/ Week:	3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EII02
Course Type:	Theory (IPCC)	Exam Hours:	3

Course objectives:

This course will enable students to study the :

1.	Behaviour of electrical circuits and apply various theorems for circuit analysis.
2.	Transient response of RLC circuits.
3.	Response of series & Parallel resonance circuits.
4.	Application of Laplace transforms for circuit analysis and the behaviour of two port networks.

UNIT I

Analysis of DC circuits: Circuit elements, Voltage and current source transformations, star–delta transformations, Loop and node analysis using super mesh, supernode with linearly dependent and independent sources.

8 Hours

UNIT II

Analysis of AC circuits: Introduction, R, L and C circuits with sinusoidal excitation, Loop and node analysis of AC Networks.

Network Theorems for DC and AC circuits: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

9 Hours

UNIT III

Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set and cut-set schedules, Principle of duality.

Resonance: Series resonance, Quality factor – Q and Bandwidth. Parallel resonance (qualitative analysis only), Parallel resonance (qualitative analysis only)

8 Hours

UNIT IV
Transient Response and Initial Conditions: Behavior of circuit elements under switching conditions and their representations. Evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitation, evaluation of initial and final conditions in RLC circuits for DC excitation
8 Hours

UNIT V
Laplace Transform and its applications: Introduction, Definition, properties, initial & final value theorem, step, ramp and impulse functions, waveform synthesis, Laplace transforms of periodic functions, solution of a network using Laplace transform. Two port network: Two port networks (z, y only) parameters, interrelationship between z and y parameters, conditions for symmetry and reciprocity.
9 Hours

TEXT BOOKS		
1	W.H. Hayt , J E Kemmerly and S M. Durbin.	Engineering Circuit Analysis 9th Edition. TMH. 2020.

REFERENCE BOOKS		
1	M E Van Valkenburg	Network Analysis. 3rd Edition. PHI. 2019.
2	Allan H. Robbins and Wilhelm C. Miller	Circuit Analysis Theory and Practice 5th Edition CENGAGE Learning 2013

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

CO1	Analyze and simulate DC networks.
CO2	Analyze and simulate AC networks, Apply network theorems in analyzing electrical networks under DC and AC excitation.
CO3	Analyze and simulate Series and parallel resonance circuits and apply basics of graph theory to solve the electrical networks.
CO4	Analyze and simulate the transient analysis in RL, RC and RLC circuits and analysis of two port networks
CO5	Apply Laplace method to analyze electric circuits and periodic functions and analyze and simulate two port networks.

Network Analysis Simulation Lab (Only For CIE) (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
1	Introduction to MATLAB and Multisim.
2	Apply Mesh and Node Analysis Techniques for Solving Electrical Circuits.
3	Verification of Superposition Theorem
4	Verification of Thevenin's Theorem
5	Verification of Norton's Theorem
6	Verification of Maximum Power Transfer Theorem
7	Design of Series RLC Circuit. Plot Frequency Response and Find Resonant Frequency, Bandwidth, Q-factor.
8	Design of Parallel RLC Circuit. Plot Frequency Response and Find Resonant Frequency, Bandwidth, Q-Factor.
9	Study the time response of first order R-L-C Network
10	Study the time response of second order R-L-C Network
11	Design and analyze Z parameters of two-port network.
12	Design and analyze Y parameters of two-port network.

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	00	SEE Marks:	50
Total Practical Hours:	00	Course Code:	S3CES02
Course Type:	Theory (PCC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1. Develop a thorough understanding of the concepts and fundamentals underlying MOSFET-based basic amplifiers.
2. Equip students with the ability to:
   - Derive small signal models of MOSFET amplifiers.
   - Analyze circuits to determine voltage gain, input impedance, and output impedance.
   - Introduce basic concepts of Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC).
   - Gain skills in designing power supplies essential for electronic circuits.
   - Understand the significance and applications of power amplifiers in electronic systems.

UNIT I

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

9 Hours

UNIT II

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

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

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

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

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze MOSFET I-V characteristics, and develop small signal models for MOSFET amplifiers.
CO2	Design and analyze Common-Source (CS), Common-Gate (CG), Common-Drain (CD), and Differential amplifiers.
CO3	Recognize the importance of Power amplifiers, and proficiently design Class A and Class B power amplifiers.
CO4	Design power supply circuits and comprehend the principles of wave shaping using diodes.
CO5	Design operational amplifier (Opamp)-based amplifiers, Schmitt triggers, function generators, and rectifiers.
CO6	Design circuits utilizing 555 timers, understand the operational principles of the 565 Phase-Locked Loop (PLL), and apply concepts related to Analog-to-Digital Conversion (ADC) and Digital-to-Analog Conversion (DAC).

ANALOG ELECTRONIC CIRCUITS LAB

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EIL01
Course Type:	Practical (PCCL)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Analyze and design the applications of diodes.
2.	Analyze and design amplifiers using MOSFET.
3.	Analyze and design the applications of Linear IC's.

List of Experiments (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
Only for Practice	
1.	Basic op-amp circuits: Inverting and Non-inverting amplifiers, Adder and Difference amplifiers.
For CIE and SEE	
1.	Integrator and Differentiator.
2.	Power supply– Full wave rectifier, Design with C filters for specific load voltage & current and ripple factor.
3.	Clipping and clamping circuits.
4.	Precision rectifiers.
5.	555 Timer – Astable and Monostable multivibrator.
6.	Sinusoidal waveform generator Wein Bridge and RC Phase shift.
7.	RC coupled single stage CE amplifier– frequency response, determination of voltage gain, input and output impedances.
8.	Class B Push-pull amplifier- determination of conversion efficiency.
Open ended experiments:	
1.	RC coupled single stage MOSFET amplifier– frequency response, determination of voltage gain, input and output impedances.
2.	LM 723 Voltage Regulators (High and Low voltage)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze, design and test Op-amp based circuits.
CO2	Design and test a regulated power supply for the given specifications.
CO3	Analyze, design and test clipping & clamping circuits.
CO4	Design and test multi-vibrators using 555 timer.

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

CHARACTERISTICS AND ERROR ANALYSIS IN INSTRUMENTATION SYSTEMS

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S3EIESC01
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Study the static and dynamic characteristics of instrumentation systems.
2.	Study the basic knowledge of errors in measurement systems and their analysis.

UNIT I
Measurement system performance: Static calibration and error calibration curve, accuracy and precision, indications of precision, significant figures, static error, static correction, scale range and scale span, reproducibility and drift, repeatability, static sensitivity, linearity, hysteresis, threshold, dead time and dead zone, resolution
9 Hours

UNIT II
Noise in measurement systems: signal to noise ratio, sources of noise, Johnson noise, power spectrum density, noise factor and noise figure, loading effects, Input and output impedances – input impedance, input admittance, output impedance, output admittance, generalized impedance and stiffness concepts, static stiffness and static compliance.
9 Hours

UNIT III
Errors in measurement systems: Limiting errors, relative limiting errors, types of errors, gross errors, systematic errors, random errors, central value, Statistical treatment of data – histogram, arithmetic mean, measure of dispersion from the mean, range, average deviation, standard deviation, variance, normal or Gaussian curve of errors, probable error.
8 Hours

UNIT IV
Response of Zero and First order systems: steady state and transient response, dynamic characteristics, Dynamic analysis of measurement systems – time domain analysis, different types of inputs, frequency domain analysis, Transfer function, Time domain response – zero order system, first order system, response of a first order system to step & ramp input, frequency response of first order system
8 Hours

UNIT V
Response of second order systems: Step response of second order system, over damped, critically damped and under damped systems, time domain specifications, frequency response of second order system, dead-time elements.
8 Hours

TEXT BOOKS		
1	A.K.Sawhney	Electrical and electronic measurements and Instrumentation, 18th Edition. Dhanpat Rai and sons. 2021

REFERENCE BOOKS		
1	Kalsi H.S.	Electronic Instrumentation, 4th Edition, McGraw-Hill-2019
2	C. S. Rangan, G. R. Sarma, V. S. V. Mani	Instrumentation: Devices and Systems, 2nd Edition, McGraw Hill Education, 2017.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Describe static and dynamic characteristics of instrumentation and measurement systems.
CO2	Analyze the various types of noise and errors, and their interpretation in instrumentation and measurement systems.
CO3	Analyze the response of instrumentation and measurement systems in time and frequency domain.

ANALOG AND DIGITAL COMMUNICATION

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S3EIESC02
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Understand the need and importance of modulation.
2.	Learn the various Amplitude and Angle Modulation and Demodulation Techniques.
3.	Study the various Pulse modulation methods and coding techniques used in digital communications.

UNIT I

Introduction: Need & Importance of modulation.
Amplitude Modulation: Principle, AM generation, modulation index, bandwidth, power in sidebands, frequency translation, Problems.

9 Hours

UNIT II

Amplitude Modulation Techniques: AM/DSB, AM-SSB/SC generation, bandwidth & power, Demodulation of AM waves, coherent & non coherent detection, effect of noise, threshold effect, FDM.

9 Hours

UNIT III

Angle Modulation: Principle of FM & PM, NBFM, WBFM, bandwidth, modulation index, generation, demodulation -frequency discriminator, phase locked loop (1st order), threshold effect in FM, pre-emphasis & de-emphasis, comparison of AM and FM.

8 Hours

UNIT IV

Pulse Modulation: Sampling theorem for low pass and band pass signal, statement and proof, practical aspects of sampling, reconstruction of signal from sampled signal, PAM, PDM and PPM generation and detection, PCM, DPCM, delta modulation, adaptive delta modulation and TDM.

8 Hours

UNIT V
Digital Communication: Methods of binary data transmission, RZ, NRZ (L) NRZ (M) NRZ(S) BiO(L) BiO(S), PSK, QPSK, DPSK, FSK, probability error for PSK & QPSK, Coding: Huffman coding, error control coding, block code.
8 Hours

TEXT BOOKS		
1	Simon Haykin & Michael Moher	Introduction to Analog and Digital Communication, John Wiley and sons Inc, 2nd Edition, 2012.
2	Hobert Taub and Donald Schilling	Principles of Communication systems, Mc Graw Hill companies, 3rd Edition, 2008.

REFERENCE BOOKS		
1	George Kennedy and Davis	Electronic Communication Systems, McGraw Hill Education, 5th Edition, 2011.
2	K Sam Shanmugam	Digital and Analog Communication Systems, John Wiley and sons Inc, Wiley Student Edition, 2008.

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

CO1	Describe the principles and generation of amplitude modulation wave.
CO2	Analyze the modulation and demodulation techniques.
CO3	Analyze different types of pulse modulation and their generation and detection.
CO4	Analyze various coding methods used in digital communication.

BIOMEDICAL INSTRUMENTATION

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S3EIESC03
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Understand the physical foundations of biological systems and the various electrodes used in the medical field
2.	Analyze the various physiological signal measurements
3.	Understanding various biomedical Instruments used for non-electrical parameter measurement provide an overview of electrical parameter acquisition and recording
4.	Understanding various techniques used for measurements in the respiratory system, pulmonary system and medical applications
5.	Classify the various instruments used for patient safety

UNIT I

Introduction to Bioinstrumentation System: The heart and cardiovascular system - electrophysiology of the cardiovascular system, physiology of the respiratory system - Nervous system - Bio-potentials, resting and action potential, propagation of action potentials - Bio-potential Electrodes, electrode behavior, and circuit models - Types of electrode-bipolar and unipolar electrodes, Limb electrodes ,floating electrodes ,pregelled disposable electrodes, surface electrodes, needle electrode and microelectrode, survey of recent electrodes used in biosignal acquisition.

09 Hours

UNIT II

Bioelectric Potential and Cardiovascular system: Types and Classification of biological signals, generation of biological signals – Filters – Amplifiers, preamplifiers, differential amplifiers, chopper amplifiers, isolation amplifiers,

Electrocardiography(ECG) waveform and its characteristics-ECG lead configurations-12 lead ECG machine circuit-Various Arrhythmias occurring in ECG signal – Holter recording

Electroencephalography(EEG): Introduction to basic Anatomy and function of brain-Bioelectric potential from the brain-10-20 system of placement of electrode-EEG Machine block diagram description Computerized analysis of EEG-Magnetoencephalography-

Electromyography(EMG): Basics of EMG- Recording of EMG

Electrooculography(EOG): Origin and measurement

Electroretinography(ERG): Origin and measurement
Phonocardiography(PCG): Origin of heart sound, Measurement of PCG –Sources of signal artifact and their implications.

09 Hours

UNIT III

Instrumentation in Photonics/Clinical Laboratory equipment:

Measurement of blood pressure: indirect Methods- Measurement of blood pressure: Direct methods- Blood flow measuring techniques: electromagnetic blood-flow meter, Ultrasonic blood flow meter-NMR blood flow meter, Laser Doppler blood flow meter

Blood gas analyzer, Acid – base balance, Blood, pH measurement, blood pCO2, blood pO2, Intra –arterial blood gas analyzers

Heart rate measurement-Invitro-oximetry, invivo-oximetry-Ear oximeter-Pulse oximeter-Skin reflectance oximeter, Intravascular oximeter.

08 Hours

UNIT IV

Respiratory, pulmonary and medical applications:

Pulmonary function measurements – Spirometer – Plethysmography – BSR (Blood sugar Random test) and GSR (Gunshot Residue) measurements.

Measurement of respiration rate: displacement method,-Thermistor method,-Impedance pneumography-Co2 method-Apnea detector-Bedside and Central Monitoring system

X-radiations, X-ray tube, X-ray machine – Radiography – Fluoroscopy - Computer tomography - Magnetic resonance imaging(MRI) - Positron emission tomography(PET) - Single photo emission computer tomography – Ultrasonography – Endoscopy - Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

08 Hours

UNIT V

Hazards and Patient Safety:

Pacemakers - Defibrillators - AC and DC defibrillators – Ventilators, methods of artificial respiration, types of ventilators - Nerve and muscle stimulators – Electrotherapy – Diathermy - Heart Lung machine - Audio meters – Dialyzers – Lithotripsy- Infant Incubators - Drug Delivery Devices, ICCU patient monitoring system Electrical safety in the medical environment, micro and macro shock hazards, electrical hazards, leakage current instruments

08 Hours

TEXT BOOKS		
1	R. S. Khandpur.	Handbook of Biomedical instrumentation', Tata McGraw Hill Publishing Co Ltd., 3rd edition, 2014.
2	John G.Webster	Medical Instrumentation application and design", Wiley India Pvt Ltd, India, 4th edition, 2015
3	Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer,	Biomedical Instrumentation and Measurements", Pearson Education, PHI Learning Private limited, India, 2nd edition., 2015

REFERENCE BOOKS		
1	Joseph J Carr and John M Brown	, "Introduction to biomedical equipment technology", Pearson Education, New Delhi, 4th edition, 2004.
2	NPTEL Course	"Mathematical Aspects of Biomedical Electronic System Design", by Prof. Chandramani Singh, IISC Bangalore

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Summarize the operation of different medical devices.
CO2	Determine the techniques to measure, detect and analyze the bio-signals
CO3	Classify the various blood pressure, blood flow measurement, Heart rate measurement techniques
CO4	Analyze and demonstrate the various techniques used for measurement of respiratory system parameters and medical imaging system for diagnosis
CO5	Analyze the medical devices diagnosis, therapeutic applications and various safety hazards

VLSI PROCESS TECHNOLOGY

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S3EIESC04
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Learn the environment for IC fabrication technology, preparation of silicon wafer and oxidation process.
2.	Understand deposition of thin film using CVD and PVD techniques.
3.	Learn incorporation of impurity in the thin film and etching process.
4.	Understand lithography techniques and various characterization tools for analyzing the properties of thin films
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.

09 Hours

UNIT II

Chemical Vapour deposition techniques: CVD techniques for deposition of materials: Plasma enhanced CVD, Atmospheric pressure CVD and Low power CVD.
Metallization: Metallization Applications, Metallization Choices, Physical Vapor Deposition (evaporation and sputtering techniques.

09 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.

08 Hours

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

UNIT V
VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, MOS Memory IC Technology. Packaging of VLSI Devices: Introduction, Package Types, Packaging Design Considerations.
08 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, 2000.
2	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the crystal growth process and select appropriate epitaxial growth techniques for IC's fabrication.
CO2	Analyze and Select appropriate deposition method to deposit various material in the thin film for IC's fabrication.
CO3	Identify and select appropriate impurity incorporation, and etching methods used in IC's fabrication
CO4	Describe the various lithography techniques used in IC's fabrication. Analyze the material properties of thin films using the various characterization techniques.
CO5	Apply various process sequences and special considerations for IC's fabrication. Select an appropriate package type and explain design considerations of VLSI devices.

SOCIAL CONNECT & RESPONSIBILITIES

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1.0
Total Lecture Hours:	00	CIE Marks:	50
Total Tutorial Hours:	00	SEE Marks:	50
Total Practical Hours:	28	Exam Hours	-
Course Type	Practical (UHV)	Sub. Code:	SHS01

Course objective: This course will enable students to:	
1	Enable the student to 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.

UNIT I

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

6 Hours

UNIT II

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsmen, 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.
5 Hours

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

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Understand social responsibility
CO2	Practice sustainability and creativity
CO3	Showcase planning and organizational skills

Ability Enhancement Course - III
(Offered by the Department)
CIRCUIT SIMULATION USING SPICE

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EIA01
Course Type:	Practical (AEC)	Exam Hours:	3

Course objective: This course will enable students to:	
1.	Understand the SPICE tool to simulate analog and digital circuits.

List of Experiments: (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
Only for CIE	
1	SPICE installation and basic Linux commands and familiarity with Linux environment.
2	Familiarity with SPICE model files.
For CIE and SEE **Circuit simulation using NG-SPICE or LT-SPICE or P-SPICE.**	
1	RC and RL - circuits: Transient analysis.
2	MOSFET I-V characteristics: DC - analysis
3	Static CMOS inverter: DC, transient and power analysis.
4	Common source amplifier. DC, operating point and AC analysis
Circuit simulation using Altium	
5	Schematic design and simulation of full wave rectifier with C-filter: transient analysis.
6	PCB layout design of full wave rectifier with C-filter.
7	Schematic design, simulation (transient analysis) and PCB-layout design of Inverting and the non-inverting amplifier using OP-AMP.
8	Schematic design, simulation (transient analysis) and PCB-layout design of Inverting and difference amplifier using OP-AMP.
Only for CIE **Open ended Experiments.**	

1	Design of power supply using ALTIUM. (Circuit Design + PCB Layout + Gerber File + Hardware design).
2	Design of instrumentation amplifier using ALTIUM (Circuit Design + PCB Layout + Gerber File + Hardware Design).
3	Design of stepper motor driver circuit using ALTIUM (Circuit Design + PCB Layout + Gerber File + Hardware Design).

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

CO1	Simulate the Characteristics of MOSFET, RLC circuit and inverter in SPICE and interpret the results.
CO2	Design schematic and simulate electronic circuits in ALTIUM and interpret the results.
CO3	Design PCB Layout for electronic circuits using ALTIUM.

VIRTUAL INSTRUMENTATION

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1.0
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EIA02
Course Type:	Practical (AEC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Familiarize with the LabVIEW and learn programming in Virtual Instrumentation.
2.	Acquire knowledge on Data Acquisition Systems and network interface concepts

List of Experiments: (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
1.	Build a Virtual Waveform Generator.
2.	Build a Virtual Instrument that simulates a Water Level Detector.
3.	Build a cluster control which consists of a seven-segment LED display, a switch, a string control and a numeric control.
4.	Build a Virtual Instrument to automate room temperature using LabVIEW
5.	Build a Virtual Instrument for Sum of N numbers using LabVIEW.
6.	Build a Virtual Instrument for Boolean operations using LabVIEW.
7.	Build a Virtual Instrument to determine the square of a given number using LabVIEW.
8.	Build a Virtual Instrument for Arithmetic operations in LabVIEW Programming.
9.	Build a Virtual Instrument for 4-bit binary to gray code converter using LabVIEW.
10.	Build a Virtual Instrument for Sequential blinking of LEDs in LabVIEW.

Open Ended Experiments:	
1	Real-Time Temperature measurement system by interfacing LM35 (Interface LM35 sensor with LabVIEW Using NI 6008 DAQ Card and Data Logging).
2	Build a Virtual Instrument for measurements of vibration using Accelerometers in LabVIEW
3	Design and test analog filters using NI-ELVIS Module.

TEXT BOOKS		
1	Dr. Sumathi. S and Prof. Surekha. P	"LabVIEW Based Advanced Instrumentation Systems", 2nd edition, 2007.
2	Jovitha Jerome	"Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd, New Delhi, 2010.
3	Gary Johnson	"LabVIEW Graphical Programming", McGraw Hill, 2006.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Develop Virtual Instruments using graphical programming.
CO2	Develop systems for signal acquisition and analysis.

PROGRAMMING WITH PYTHON

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EIA04
Course Type:	Practical (AEC)	Exam Hours:	3

For those who have not studied Python programming in 1st year

Course objective:	
This course will enable students to:	
1.	Learn programming concepts using python.

List of Experiments: (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
Only for CIE	
1.	Python program to find the best of two test average marks out of three test marks accepted from the user
2.	Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number
3.	Python program which accepts a value for N (where N >0) as input and passes this value to the function. Display a suitable error message if the condition for input value is not followed.
4.	Python program to convert binary to decimal, octal to hexadecimal using functions.
5.	Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.
6.	Python program to implement insertion sort and merge sort using lists
7.	Python function called is phone number () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression.
8.	Python program to find the area of triangle, circle and rectangle. Note: Use the concept of inheritance.
9.	Python program by creating a class called Employee to store the details of Name, Employee_ID, Department and Salary, and implement a method to update salary of employees belonging to a given department.
10.	Python program to read the data from the spreadsheet and write the data into the spreadsheet.

Course Outcomes: Upon completion of the course, the student will be able to:	
CO1	Implement exemplary applications to solve basic math and file operations.
CO2	Develop programs and interpret the concepts of Object-Oriented Programming in Python.

DATA ANALYTICS WITH R PROGRAMMING

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1.0
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S3EIA05
Course Type:	Practical (AEC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Learn R Programming language.
2.	Study data analytics and data visualization.
3.	Understand statistical analysis using normal distribution.

List of Experiments: (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
1.	Vector, data objects.
2.	Matrix, array and factors.
3.	Data frames.
4.	Creation and manipulation of sample data.
5.	Control structures.
6.	Data Manipulation using R packages (dplyr and data.table).
7.	Data analysis with normal distribution.
8.	Data Visualization with ggplot2.

TEXT BOOKS		
1.	W. N. Venables, D.M. Smith and the R Development Core Team.	An Introduction to R: Notes on R: A Programming Environment for Data Analysis and Graphics, Version 4.3.1 (2023-06-16) (eBook).

REFERENCE BOOKS		
1.	Jared P Lander	R for Everyone: Advanced analytics and graphics, Pearson Education, 2nd Edition, 2017
2.	Ajit C, Tamhane, Dorothy D, Dunlop	Statistics and data analysis: From Elementary to Intermediate, Prentice Hall, 2nd Edition, 2000.
3.	G Casella and R.L. Berger	Statistical Inference, Thomson Learning, 2nd Edition, 2007.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Develop programs using R-data types, objects and frames.
CO2	Perform data analysis and visualization using R-programming.

NATIONAL SERVICE SCHEME (NSS)

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	00
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	SMC01
Course Type:	Theory (MC)	Semester:	III to VI

Course objectives:
This course will enable students to:

1.	Understand the community in which they work.
2.	Understand themselves in relation to their community
3.	Identify the needs and problems of the community and involve them in problem solving process
4.	Develop among themselves a sense of social and civic responsibility
5.	Utilize their knowledge in finding practical solution to individual and community problems
6.	Gain skills in mobilizing community participation
7.	Acquire leadership qualities and democratic attitude
8.	Develop capacity to meet emergencies and natural disasters
9.	Practice national integration and social harmony

UNIT I

Basic concepts of NSS: Introduction and Basic Concepts of NSS, Emblem, flag, motto, song, badge, etc., Organizational structure, roles and responsibilities of various NSS functionaries, Concept of regular activities, special camping, Day Camps, Basis of adoption of village/slums, Methodology of conducting Survey, Maintenance of the Diary, Issues, challenges and opportunities for youth.

9 Hours

UNIT II

Introduction to Volunteering: Volunteer, Volunteerism, Benefits of volunteerism, Volunteer Opportunities, Rights as a Volunteer, Indian Tradition of volunteerism, Needs & importance of volunteerism, Motivation and Constraints of Volunteerism, Shramdan as a part of volunteerism.

8 Hours

UNIT III
General Awareness programs: Water conservation awareness, Road safety awareness, National Integration Programme, Education Awareness, Swachh Bharat Abhiyan, Awareness campaign for traffic rules, Environmental protection awareness, Covid-19 Protocol Awareness, Mission Shakti (Women's empowerment awareness).
8 Hours

UNIT IV
Health and Education: Concept of community and society, Human values, Gender justice, Food and Nutrition, National health programme, Healthy Lifestyles, HIV AIDS, Drugs and Substance abuse, First Aid, Concept of yoga, Yoga as a tool for healthy lifestyle.
8 Hours

UNIT V
Society Awareness and programs: Plantation Awareness, Fit India movement, Health awareness, Waste management awareness, Production of bio-fertilizer from biological waste, Blood donation awareness, Awareness for self-Employment in adapted village.
9 Hours

TEXT BOOKS		
1	Amit K Jain & Brijesh K Rathi Panwar	National Service Scheme: A Youth Volunteers Programme for Under Graduate Students as Per UGC Guidelines.

REFERENCE BOOKS		
1	Nirmalya Kumar Sinha and Dr.Surajit Kumar Majumder	Text Book of National Service Scheme (Volume –I)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Improve the quality of educated manpower by fostering social responsibility.
CO2	Raising society to a higher material and moral level by preparing students for final dedication in the service of nation.
CO3	Introduce urban students to rural life by living in contact with the community in whose midst their institution is located
CO4	Making campus relevant to the needs of the community
CO5	Develop constructive linkage between the campus and the community by supplementing technical education with social and economic reconstruction of the country.
CO6	Involvement in the tasks of national development
CO7	Better understanding and appreciation of the problems of the society
CO8	Encourage Community participation

PHYSICAL EDUCATION

Contact Hours/ Week:	2+2+0 (L+T+P)	Credits:	0.0
Total Lecture Hours:	28	CIE Marks:	50
Total Tutorial Hours:	28	SEE Marks:	50
Total Practical Hours:	00	Course Code:	SMC02
Course Type:	Theory (PCC)	Semester	III to VI

KHO-KHO

Course objectives:
This course will enable students to:

1.	To learn the rules, fundamental skills, and strategies of Kho-Kho.
2.	To learn basic offensive and defensive patterns of play.
3.	To use different parts of the body in utilizing the above skills while playing Kho-Kho.
4.	Students will understand the basic fundamentals of a Kho-Kho game, how and when to move, where and why.
5.	To develop a positive attitude towards Kho-Kho as a lifetime sport and to improve physical fitness through participation in Kho-Kho.

UNIT I

- History of Kho-Kho.
- National tournaments, Records and outstanding players

UNIT II

- Fundamental skills- Drills & lead up activities

UNIT III

- Offensive skills- Sitting in the square, Giving Kho, proximal method, distal method, faking kho, late kho,
- Pole Turning, Pole Dive, Diagonal Attack, Tapping and Diving

UNIT IV

- Defensive skills- Zig-Zag run, 3-3-2 chain and 1-4-5-6 chain, short ring, medium ring and long ring.

UNIT V

- Equipment's, Ground marking, Rules and regulations, Signals of officials and their interpretations.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Learn basic skills and knowledge associated with Kho-Kho.
CO2	Demonstrate the knowledge of the rules of the game.
CO3	Improve foot work skills and drills in order to execute court coverage in Kho-Kho with different drills.
CO4	Improve physical fitness and practice positive personal and lifestyle.
CO5	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

CRICKET

Course objectives: This course will enable students to:	
1.	To learn the rules, fundamental skills, and strategies of Cricket.
2.	To learn basic offensive and defensive patterns of play
3.	To use different parts of the body in utilizing the above skills while playing Cricket.
4.	To develop a positive attitude towards Cricket as a lifetime sport and to improve physical fitness through participation in Cricket.

UNIT I
History of Cricket. National and International level tournaments, Records and outstanding players.

UNIT II
• Fundamental skills- Batting grip, back lift, forward batting, cover drive, late cut, leg glance, Pull shots, • Hook shot, straight drive and running between wickets.

UNIT III
• Bowling grip, run up, delivery and follow through, length and line, pace bowling, in swing, out swing. Leg spin. Off spin and Goodly and leg cutter.

UNIT IV
• Fielding- Ground ball, catching, fly ball, slip fielding and fielding positions. Wicket Keeping.

UNIT V
● Equipment's-Ball, Bat, Wickets, Bails. ● Ground marking, Rules, Signals of officials and their interpretations..

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Cricket.
CO2	Apply these skills while playing Cricket and exhibit improved performance
CO3	Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
CO4	Improve physical fitness and practice positive personal and lifestyle.
CO5	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

VOLLEYBALL

Course objectives: To learn the rules, fundamental skills, and strategies of volleyball:	
1.	To develop skills in passing, setting, serving, spiking, and blocking.
2.	To learn basic offensive and defensive patterns of play.
3.	To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

UNIT I
● History of Volleyball. ● Measurements and Specification of Equipment's. ● Sports Awards in Volleyball.

UNIT II
Players Stance, Receiving and passing ● The Volley (Overhead pass), The Dig (Underhand pass).

UNIT III
● Service Reception - Under Arm Service, Jump Service, Side Arm Spin Service, Round Arm Service, ● High spin service, Asian serve / American serve (floating). ● Setting the ball- Set for attack, Back set, Jump set.

UNIT IV
● Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash. ● Block- Single block, Double block, Three-man block. ● Rolls- Overhead pass & back rolling, one hand underhand pass with side rolling, Forward dive.

UNIT V
● Attack Combination, Defense Systems, Libero play. ● Court marking, Rules and their interpretations and Duties of officials.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with volleyball.
CO2	Apply these skills while playing volleyball and exhibit improved performance
CO3	Improve physical fitness and practice positive personal and lifestyle.
CO4	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

BASKETBALL

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of Basketball
2.	To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.
3.	To learn basic offensive and defensive strategies of play.
4.	To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
5.	To develop positive understanding and appreciation of the basketball game.

UNIT I

- History of Basketball.
- Measurements and Specification of Equipment's.
- Sports Awards in Basketball.

UNIT II

- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, Overhead pass, Underhand pass, Hook Pass
  Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

UNIT III

- Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations
- Shooting- Layup shot and its variations, one hand set shot, One hand jump shot, Free throw,
- Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

UNIT IV
• Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization. • Individual Defensive- Guarding the man with the ball and without the ball. • Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics.

UNIT V
• Court marking, official signals, Rules and their interpretations.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with basketball.
CO2	Apply these skills while playing basketball and exhibit improved performance
CO3	Improve physical fitness and practice positive personal and lifestyle.
CO4	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

ATHLETICS (TRACK AND FIELD)

Course objectives:	
1.	To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump and shot put and practice them.
2.	To develop competence among students in demonstrating all the techniques covered in the course.
3.	To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
4.	To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
5.	To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

UNIT I

- Athletics: Introduction
  Track Events - Steeple Chase, Race Walking, Middle and Long distance races
- Race walking - Technique, Faults and Officiating.
- Middle and Long distance races – Technique and Training

UNIT II

- Jumping Events - High Jump and Triple Jump: Basic Skills and techniques
- High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air,
  Clearance over the bar & Landing
- Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

UNIT III

- Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques
- Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance,
  Release and Reverse (Follow through)
- Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through.

UNIT IV
● Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Course Outcomes:	
On completion of the course learners will be able to:	
CO1	Display competencies in executing basic techniques and skills associated with select track and field events.
CO2	Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
CO3	Learn regular practice of select track and field events and improve physical fitness
CO4	Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

KABADDI

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of Kabaddi.
2.	To learn basic offensive and defensive patterns of play.
3.	To use different parts of the body in utilizing the above skills while playing Kabaddi.
4.	Students will understand the basic fundamentals of a Kabaddi game, how and when to move, where and why.
5.	To develop a positive attitude towards Kabaddi as a lifetime sport and to improve physical fitness through participation in Kabaddi.

UNIT I
● Introduction of rules and regulations of Kabaddi. ● National and International level tournaments, Records and outstanding players.

UNIT II
● Fundamental skills- Drills & lead up activities.

UNIT III
● Offensive skills- Hand touch, Foot touch, Toe touch, sudden leg thrust, the roll, side kick, ● front kick and back kick.

UNIT IV
● Defensive skills- ankle hold, Thigh hold, Knee hold/ double knee hold, the waist/ trunk/back hold. ● The tackle and wrist hold

UNIT V
● Equipment's, Ground marking, Rules, Signals of officials and their interpretations

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Kabaddi.
CO2	Perform and demonstrate the two basic strokes.
CO3	Demonstrate the knowledge of the rules of the game.
CO4	Improve foot work skills and drills in order to execute court coverage in Kabaddi with different drills.
CO5	Improve physical fitness and practice positive personal and lifestyle.
CO6	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

FOOTBALL

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of football.
2.	To develop skills in passing, receiving, controlling the ball, tackling, a defender and heading in football.
3.	To use different parts of the body in utilizing the above skills while playing football.
4.	To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

UNIT I
● **History of Football.** (a) Origin and Development of football (b) Formation, Structure & Functions of FIFA, AFC & AIFF.

UNIT II
● **Laws of the game and their interpretations.** (a) Interpretation and critical analysis of laws of the game.

(b) Signals by the Referee and the Assistant Referee.
(c) The laws of the game & Coach.
(d) Relationship between tactics and Laws of the game.

UNIT III

- **Organization and management of competition**
  (a) Competition system and qualifying system being followed in the game at
  (1) Olympics (2) FIFA World Cup (3) Major Tournaments/Championships in India.
  (b) Drawing of Fixtures
  (c) Conduct of tournaments

UNIT IV

- **Development of football techniques**
  (i) Techniques without ball
  (a) Running technique
  (b) Changing of direction
  (c) Jumping
  (d) Feinting.

  (ii) Techniques with ball.
  a) Different types of kicking.
  b) Different types of ball controlling/trapping
  c) Different types of heading Dribbling and feinting
  d) Different types of tackling
  e) Interception
  f) Throw-in
  g) Goalkeeping.

UNIT V

- **Development of personal performance and demonstration ability in the following techniques.**

Throw-in- Standing and Sliding.

a) Kicking
b) Controlling the ball/ball reception
c) Heading
d) Feinting
e) Tackling
f) Throw in
g) Passing and supporting play
h) Shooting at goal
i) Goal –keeping
j) Dribbling.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with football.
CO2	Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
CO3	Improve physical fitness and practice positive personal and lifestyle.
CO4	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

BADMINTON

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of Badminton.
2.	To develop skills in attacking, receiving, smashing.
3.	To learn basic offensive and defensive patterns of play
4.	To use different parts of the body in utilizing the above skills while playing Badminton.
5.	Students will understand the basic fundamentals of a Badminton game, how and when to move, where and why.
6.	To develop a positive attitude towards Badminton as a lifetime sport and to improve physical fitness through participation in Badminton.

UNIT I

- History of Badminton.
- National and International level tournaments, Records and outstanding players.

UNIT II

- Fundamental skills- Drills & lead up activities.
- Grip-Back hand, fore hand.

UNIT III

- Stance- Attacking Stance, Defensive Stance, Net stance.
- Footwork- Move only 2-3 steps backward, shuffle only 1 step sideward, Move only 2-3 steps front.
- Smash- fore hand, Back hand and Jumping smash. Drop shot.

UNIT IV
● Offensive skills-service-high service, short service, flicks service. ● Under arm fore hand clear and under arm back hand clear.

UNIT V
● Equipment's, Ground marking, Rules, Signals of officials and their interpretations.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Badminton.
CO2	Perform and demonstrate the two basic strokes.
CO3	Demonstrate the knowledge of the rules of the game.
CO4	Improve foot work skills and drills in order to execute court coverage in badminton with different drills.
CO5	Improve physical fitness and practice positive personal and lifestyle.
CO6	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

THROWBALL

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of Throwball.
2.	To use different parts of the body in utilizing the above skills while playing Throwball.
3.	Students will understand the basic fundamentals of a Throwball game, how and when to move, where and why.
4.	To develop a positive attitude towards Throwball as a lifetime sport and to improve physical fitness through participation in Throwball.

UNIT I
● History of Throwball.

UNIT II
● Fundamental skills- Drills & lead up activities.

UNIT III

- Offensive skills
- Services
  a. Simple service.
  b. High service.
  c. Spin service.
  d. High spin service.
- Throw
  a. Spin throw.
  b. High throw.
  c. Jump & throw

UNIT IV

- Defensive skills- receive-four hands receive & back hand receive..

UNIT V

- Equipment's, court marking, Rules, Signals of officials and their interpretations.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Throwball.
CO2	Perform and demonstrate of the basic skills.
CO3	Demonstrate the knowledge of the rules of the game.
CO4	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

HOCKEY

Course objectives:	
1.	To learn the rules, fundamental skills, and strategies of Hockey.
2.	To learn basic offensive and defensive patterns of play.
3.	To use different parts of the body in utilizing the above skills while playing Hockey.
4.	Students will understand the basic fundamentals of a Hockey game, how and when to move, where and why.
5.	To develop a positive attitude towards Hockey as a lifetime sport and to improve physical fitness through participation in Hockey.

UNIT I

- History of Hockey.
- National and International tournaments, Awards and outstanding players.

UNIT II

- Fundamental skills- Drills & lead up activities.
- Passing-short pass, long pass, push pass and Hit.
- Trapping..

UNIT III

- Skills-Deception, Defense, Dribbling, First touch, Flat stick tackling, Jab, Passing, Position, leading and Running

UNIT IV

- Skills-penalty stroke practice.
- Penalty corner practice.
- Goal keeping, Ball clearance-kicking and deflecting..

UNIT V

- Game practice with applications of rules and regulations.
- Equipment's, Ground marking, Signals of officials and their interpretations.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Hockey.
CO2	Demonstrate the knowledge of the rules of the game.
CO3	Improve foot work skills and drills in order to execute court coverage in Hockey with different drills.
CO4	Improve physical fitness and practice positive personal and lifestyle.
CO5	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

TABLE TENNIS

Course objectives:	
1.	The overall objective of the game of Ping-Pong is to win the match by winning enough points to win more than half of the number of maximum possible games to be played between you and your opponent (in singles), or you, your partner and your two opponents (in doubles).
2.	A secondary objective (and some would say the main objective) is to have fun and get a bit of exercise at the same time.
3.	To develop a positive attitude towards Table Tennis as a lifetime sport and to improve physical fitness through participation in Table Tennis.

UNIT I

- History of Table Tennis.
- Measurements and Specification of Equipment's.
- Sports Awards in Table Tennis.

UNIT II

- Players Stance, Footwork.
- Racquet Grip, four hand grip and back hand grip..

UNIT III

- Service- Four hand, Back hand and Spin.
- Pushes- Four hand and Back hand

UNIT IV
● Spinning-Top spin, back spin, right side spin and back side spin. ● Loops and speed..

UNIT V
● Measurement of board, specifications, Rules and their interpretations and Duties of officials.

Course Outcomes: On completion of the course learners will be able to:	
CO1	Learn basic skills and knowledge associated with Table Tennis..
CO2	Apply these skills while playing Table Tennis and exhibit improved performance.
CO3	Improve physical fitness and practice positive personal and lifestyle.
CO4	Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork

4th Semester

TRANSDUCERS AND MEASUREMENTS

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S4EI01
Course Type:	Theory (PCC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Study functional elements and static characteristics of instruments
2.	Understand the construction and characteristics of sensors
3.	Understand the working of AC and DC bridges and various measuring instruments

UNIT I

Functional elements of an instrument: Transducer and classification: Primary & Secondary, active & passive transducers, analog & digital modes of operation, null & deflection methods. I/O configuration of measuring instruments & instrument system– methods of correction for interfering & modifying inputs.
Static characteristics: Meaning of static calibration, accuracy, precision & bias. Combination of component errors in overall system-accuracy calculation. Static sensitivity, linearity, threshold, resolution, hysteresis and dead space.

9 Hours

UNIT II

Physical Sensors: Displacement, Temperature & Pressure: Capacitive transducer – various arrangements, Inductive transducer, LVDT, RTD temperature characteristics, thermistor characteristics, Active type: Thermocouple – characteristics. Optical and Radiation Pyrometers: Fundamentals, Radiation detectors, Strain gauges-types, Gauge factor, configuration. Pressure sensor types: Elastic and gravitational.

9 Hours

UNIT III
Flow, Level and Speed measurement: Mechanical Flow meters: Principle of Obstruction flow meters, Orifice, Venturi, Nozzle and Pitot static tube, Electro Magnetic, Turbine, Ultrasonic flow meter. Level measurement: Capacitance probe, conductivity probe, Ultrasonic level detector. Speed measurement: AC tachometer and DC tachometer.
8 Hours

UNIT IV
Miscellaneous measurements: Torque measurement - Mechanical and Electrical method of torque measurement. Humidity - Resistive, Capacitive and Piezoelectric, Moisture, pH, Density measurements, Proximity sensor, RFID, Peizo-Electric sensor, Blood –glucose analysers, Oximeter, Hall-effect sensors.
8 Hours

UNIT V
Measuring Instruments: DC & AC bridges- Wheatstone bridge, Maxwell, Schering and Wien bridges, Four probe method of measuring electrical properties, Electronic Instruments for Measuring Basic Parameters: Electronic multimeter, Digital voltmeter, Vector Voltmeter, Storage Oscilloscope, Sampling Oscilloscope, LCD, LED & Touch screen display.
8 Hours

TEXT BOOKS		
1	Kalsi H.S.	Electronic Instrumentation, 3rd Edition, TMH-2018
2	Ernest O. Doebelin	Measurement systems application and design, 6th Edition. McGRAW HILL, 2017
3	A.K.Sawhney	Electrical and electronic measurements and Instrumentation, 18th Edition. Dhanpat Rai and sons. 2021

REFERENCE BOOKS		
1	Patranabis D	Instrumentation and control, 1st Edition, PHI Publications,2011
2	Nakra and Chaudhary.	Instrumentation Measurement and Analysis McGRAW HILL. 4th Edition,2016
3	Gupta J.B.	Electrical and electronic measurements and Instrumentation, 10th Edition. Kataria, 2013.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Identify the functional elements of an instrument and analyze the static characteristics of instruments.
CO2	Analyze the construction and working of various industrial devices used to measure Displacement, Temperature & Pressure.
CO3	Analyze the different methods for the measurement of Flow, Level, Speed and Torque
CO4	Describe different techniques to measure humidity, distance, blood glucose, oxygen saturation and magnetic field
CO5	Identify and analyze the functional units of various measuring instruments.

CONTROL SYSTEMS

Contact Hours/ Week:	3+0+2 (L+T+P)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	26	Course Code:	S4CESI01
Course Type:	Theory (IPCC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1	Develop a mathematical model 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 and applications of different types of feedback controllers to control systems.
3	Perform Stability analysis of a given system using Routh-Hurwitz criterion and Root locus techniques.
4	Perform Stability analysis of a given system in frequency domain using Bode plots and obtain Gain margin & phase margins.
5	Perform Stability analysis using Nyquist Stability criterion, obtain -Gain and phase margin. Design 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 physical systems–mechanical systems, Electrical systems.

· Translational and rotational systems

· Transfer function of Electrical networks, Relevant examples

Signal flow graphs: signal Flow graph, Mason's gain formula applicable to Electrical and Electronics systems.

9 Hours

UNIT II

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

Feedback Controllers: Design of feedback controllers based on time response applicable to Electrical & Electronics systems. Relevant examples.

9 Hours

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

UNIT IV
Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response(Transfer function) from Bode Plot, Stability analysis in Electrical & Electronics systems.
8 Hours

UNIT V
Frequency-response analysis: Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin. System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to Electrical [KNm3] & Electronics systems.
8 Hours

TEXT BOOKS		
1	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Ed. 13, Pearson Education, 2013,
2	Nagrath and Gopal M.	Control Systems Engineering. Ed. 4, New Age International (P) Limited. 200ISBN 10: 8122422845
3	Adel S. Sedra, Kenneth C. Smith	Microelectronic Circuits: Ed 5, New York Oxford University Press 2004.

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

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 stability of linear-time-invariant systems.
CO3	Analyze and interpret the stability of linear-time invariant systems by applying RH criteria and root locus techniques.
CO4	Analyze and interpret the stability of linear-time-invariant systems in frequency domain analysis by polar plot and Bode plot techniques.
CO5	Analyze and interpret the stability using Nyquist plot criterion, Design and analyse the Lead, lag and lead-Lag compensators for improving the stability and performance of linear-time-invariant systems.

CONTROL SYSTEMS LAB: (Only for CIE) (2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment	
1.	Simulation of second order system and determination of step response and evaluation of time domain specifications for any given electrical systems(using 20SIM/MATLAB)/
2.	To study time response (transient and steady state) of a second order system [x<1, x=1 & x>1](Hardware).
3.	To study the effect of P, PI, PD & PID controllers for step response of a feedback control system (H/W) & software (MATLAB).
4.	To design a phase- LAG, Phase-Lead and Phase Lead-Lag compensating network for the given specifications and determine maximum phase lead, phase lag and obtain its frequency response (Hardware and Software).
5.	Analyse the stability of the given system using Root Locus technique (20sim/MATLAB).
6.	Evaluation of the effect of addition of poles and zeroes on stability of the given ystem using Root locus technique(20sim/MATLAB).
7.	Analyse the stability of the given system using Bode plot technique (20sim/MATLAB)
8.	Analyse stability of the given system suing Bode plot technique.(20Sim/MATLAB).
9.	Analyse the stability of the given system using Nyquist plot technique (20sim/MATLAB)
10.	Analyse stability of the given system using polar and Nyquist plot technique.(20Sim/MATLAB).

ARM MICROCONTROLLER

Contact Hours/ Week:	3+0+2 (L+T+P)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S4CESI02
Course Type:	Theory (IPCC)	Exam Hours:	3

Course objectives:
This course will enable students to:

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

UNIT I

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

9 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.

8 Hours

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

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

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

Integrated Lab Using Embedded C and/ or LPC 2148

(2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment

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

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).

SENSORS AND MEASUREMENTS LAB

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S4EIL01
Course Type:	Practical(PCCL)	Exam Hours:	3

Course objective: This course will enable students to:	
1.	Understand the working of various sensors and method to determine the range, linearity, Sensitivity and hysteresis

(2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment **List of Experiments:**	
1	Characteristics of RTD and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
2	Characteristics of AD590 and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
3	Characteristics of LVDT and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
4	Characteristics of Capacitive transducer and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
5	Characteristics of cantilever beam strain gauge for quarter, half and full bridge and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
6	Characteristics of Load cell and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
7	Characteristics of hall effect proximity sensor and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
8	Characteristics of flow meter and calculation of linearity and sensitivity using software tools.
9	Characteristics of thermistor and calculation of range, linearity, Sensitivity and hysteresis by using software tools.
Open ended experiments (only for CIE)	
1	Design of Signal conditioning Circuit using thermocouple for measurement of temperature.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the characteristics of various temperature sensors.
CO2	Analyze the characteristics of strain and load cell.
CO3	Analyze the characteristics of displacement, proximity and flow sensors.

Engineering Science Courses (ESC/ETC/PLC)

COMPUTER ORGANIZATION

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S4EIESC01
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Learn the basics of organizational and architectural issues of a digital computer
2.	Understand performance issues in processor and memory design of a digital computer.
3.	Study various data transfer techniques in digital computer.
4.	Understand processor performance improvement using instruction level parallelism

UNIT I
Structure of Computer: Functional Units, Basic Operational Concepts, Bus Structures, Performance- Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Operations, Instructions and Instruction Sequencing, Addressing Modes
9 Hours

UNIT II
Bus organization: Stacks and Queues, Subroutines, Basic Processing Unit, Single bus organization, Execution of a Complete Instruction, Multiple Bus Organization, and Hard wired Control and Micro programmed Control Unit.
9 Hours

UNIT III
Arithmetic operations: Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating Point Numbers.
8 Hours

UNIT IV
Input/Output Organization: Accessing I/O Devices, Interrupts-Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Bus Arbitrations.
8 Hours

UNIT V
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size and Cost, Introduction to cache Memory and its mapping.
8 Hours

TEXT BOOKS		
1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky.	Computer Organization. 5th Edition. TMH. 2002.
2	Divid A. Patterson, John L. Hennessy	Computer Organization and Design RISC V Edition 2nd Edition, Morgan Kaufmann, Elsevier, 2020

REFERENCE BOOKS		
1	William Stallings.	Computer Organization & Architecture. 7th Edition. PHI. 2006
2	Vincent P. Heuring & Harry F. Jordan	Computer Systems Design and Architecture. Ed2. Pearson Education. 2004.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Identify the functional units of a computer and evaluate the performance of processors.
CO2	Analyze single bus and multiple bus operation.
CO3	Implementation of arithmetic operations and represent numbers in floating point.
CO4	Analyse the instruction set and interrupt concepts of a general computer system.
CO5	Illustrate the functionalities of different memory organizations.

POWER ELECTRONICS

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S4EIESC02
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Study the construction and operation of various power devices.
2.	Understand the design of various converter for industrial applications

UNIT I

THYRISTORS: Introduction to thyristor family, structure of SCR and modes of operation, SCR turn-on and turn-off characteristics, snubber circuit, Triggering circuits (R and RC), Commutation circuits for SCR (natural and complimentary commutation), thyristor types (construction and operation of TRIAC and DIAC only).

9 Hours

UNIT II

SINGLE PHASE AC-DC CONVERTER: Introduction, principle of phase controlled converter operation, single phase half wave, semi converter and fully controlled converters with R-L loads and freewheeling diodes, problems.

9 Hours

UNIT III

DC TO DC CONVERTER: Step-down and step-up chopper, chopper classifications, analysis of Buck, Boost regulator and impulse commutated chopper, problems.

8 Hours

UNIT IV

INVERTERS: Introduction, principle of operation, single phase bridge inverters, voltage control of single phase inverters: Sinusoidal PWM modified sinusoidal PWM, current source inverter.

8 Hours

UNIT V
AC TO AC CONVERTERS: Introduction, principle of On-off control, principle of phase control, Single phase AC voltage controllers with resistive load, problems, introduction to single phase cycloconverters, problems.
8 Hours

TEXT BOOKS		
1	M. H. Rashid	Power Electronics, 3rd edition, PHI / Pearson publisher, 2004, 3rd Edition.

REFERENCE BOOKS		
1	P.C. Sen	Modern Power Electronics, S.Chand, 2000, 2nd Edition.
2	NedMohan, T.M Undeland & W.P Robbin,	Power Electronics: Converters, Application and Design, 2006, John Wiley and sons, Wiley India edition

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain the characteristics of power semiconductor devices, design and compare different triggering methods.
CO2	Analyze and Design controlled rectifier for industrial applications.
CO3	Analyze and Design DC to DC converter for control applications.
CO4	Analyze and Design inverter for industrial applications.
CO5	Analyze and Design AC-AC converters for industrial applications.

FOUNDATIONS OF MACHINE LEARNING

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S4EIESC03
Course Type:	Theory (ESC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Understand the design steps of a machine learning and algorithms.
2.	Learn decision tree algorithm.
3.	Understand perceptron neural network and learning algorithms for multilayer perceptron.
4.	Understand Instance based learning algorithms.
5.	Understand unsupervised learning algorithms.

UNIT I
Introduction: Well posed learning problems, Designing a Learning system, Perspectives and Issues in Machine Learning. Concept Learning: A Concept learning task, Concept learning as search, Find-S: Finding a maximally specific hypothesis, Version spaces and the Candidate Elimination algorithm.
9 Hours

UNIT II
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, The Basic decision tree learning algorithm (ID3, CART). Hypothesis space search in decision tree learning, Issues in decision tree learning.
9 Hours

UNIT III
Artificial Neural Networks: Introduction, biological motivation, neural network representations, and appropriate problems for Neural network Learning, Perceptron, Multilayer Networks, and the backpropagation algorithm. A Differentiable threshold unit, the backpropagation Algorithm.
8 Hours

UNIT IV
Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, comparing learning algorithms **Instance-based Learning:** Introduction, k-nearest neighbor learning, Distance-Weighted Nearest Neighbor Algorithm, and Remarks on k-Nearest Neighbor Algorithm.
8 Hours

UNIT V
Unsupervised Learning: Cluster analysis. Partitioning Methods: k-Means, Hierarchical Methods: Agglomerative vs Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods.
8 Hours

TEXT BOOKS		
1	Tom M Mitchell	Machine Learning, McGraw Hill Education, 1st Edition, 2017.
2	Richard O Duda, Peter E Hart, David G Stock	Pattern Classification, John Wiley and Sons, 2nd Edition, 2012.

REFERENCE BOOKS		
1	Ethem Alpaydin	Introduction to Machine Learning, 3rd Edition, EEE, MIT Press, 2018.
2	SaikatDutt, Subramanian Chandramouli, Amit Kumar Das	Machine Learning, Pearson Education, 1st Edition, 2019.
3	S.Theodoridis and K.Koutroumbas	Pattern Recognition, Academic Press, 4th Edition, 2009.

Course Outcomes: Upon completion of this course, the student will be able to:	
CO1	Describe basics of machine learning and concept learning techniques.
CO2	Classify data using the concept of decision tree learning algorithms.
CO3	Develop neural networks for learning linear, and non-linear functions.
CO4	Derive effective learning rules for finding solution to real-world problems using Bayesian algorithm.
CO5	Describe unsupervised learning algorithms and apply it to solve real-world problems.

DIGITAL SYSTEM DESIGN

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	S4EIESC04
Course Type:	Theory (ESC)	Exam Hours:	3

Course objective:
This course will enable students to:

1.	Study the Programmable Logic Devices for system design.
2.	Design of combinational circuits and sequential circuits
3.	Study the memory control units and develop HDL.

UNIT I

Programmable Logic Devices: PLA PAL and PROM, CPLD, FPGA, FPGA architecture, FPGA- CLBs, switch matrix and IOB, Configurable Logic Blocks (CLBs). FPGA design flow.
Combinational Circuit Design: Combinational circuit design using Verilog HDL: n-bit ripple carry adder, n:m multiplexer, n-bit magnitude comparator.

9 Hours

UNIT II

Synchronous Sequential Circuit Design: Finite State Machines and controllers, state diagram, designing FSM using state graph, synchronous circuit design using both Mealy and Moore Finite State Machines using Verilog HDL: n-bit registers, n-bit synchronous counter,

9 Hours

UNIT III

Synchronous Sequential Circuit Design: Sequence detector, shift and add multiplier, serial adder.
Sequential Memory Elements: Sequential memory units and its operation. Control unit design for sequential memory units using Verilog HDL: FIFO circular buffers and STACK.

8 Hours

UNIT IV
Designing Data path elements: Designing MxN multiplier, arithmetic logic unit, n-bit accumulator, n-bit MAC using Verilog HDL. **Timing in Synchronous Circuit Design:** Synchronous timing basics. Sources of clock skew and jitter, pipelined circuit design using Verilog HDL: k-stage pipelined NxM multiplier.
8 Hours

UNIT V
Fixed and Floating point Arithmetic: Fixed point number system and floating point number system, arithmetic operation on fixed and floating point numbers. Fixed point and floating point arithmetic circuit design using Verilog HDL, n-bit fixed point multiplier, floating point multiplier design.
8 Hours

TEXT BOOKS		
1	Samir Palnitkar	Verilog HDL A guide to Digital Design and Synthesis, 2nd Edition, Pearson Education 2017
2	Moris Mano Michael D Ciletti	Digital Design: With an Introductions to the Verilog HDL, VHDL and System Verilog. 6th Edition, Pearson Education 2018

REFERENCE BOOKS		
1	Charles Roth , Lizy Kurian John, Byeong Kil Lee	Digital Systems Design Using Verilog, Cengage India Private Limited. Inc. 1st Edition 2017.
2	Frank Vahid	Digital Design with RTL Design, VHDL, and Verilog 2nd Edition, John Wiley and Sons Publishers, 2011.
3	Jan M Rabaey, Anantha Chandrakasan, Borivoje Nikolic	Digital Integrated Circuit A Design Perspective, 2nd Edition, PHI. 2016.
4.	Cem Unsalan Bora Tar	"Digital System Design with FPGA: Implementation Using Verilog and VHDL", McGraw Hill Education; First Edition, 2017

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze and design combinational circuits and develop Verilog HDL program.
CO2	Analyze and Design Synchronous Sequential circuits and develop Verilog HDL program.
CO3	Analyze and Design the control unit for sequential memory elements and develop the Verilog HDL program.
CO4	Analyze timing constraints of synchronous sequential circuits, design pipelined circuits and develop Verilog HDL program.
CO5	Design digital circuits to perform fixed point and floating point arithmetic operations and develop Verilog HDL program.

BIOLOGY FOR ENGINEERS

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	00	SEE Marks:	50
Total Practical Hours:	00	Exam Hours	3
Course Type	Theory (BSC)	Sub. Code:	S4CCA01

Course objectives:

This course will enable students to:

1.	Familiarize the students with the basic biological concepts and their engineering applications.
2.	Enable the students with an understanding of biodesign principles to create novel devices and structures.
3.	Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4.	Motivate the students to develop an interdisciplinary vision of biological engineering.

UNIT I

INTRODUCTION TO BIOLOGY:

The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones.

9 Hours

UNIT II

BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE):

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, lignolytic enzyme in bio-bleaching).

9 Hours

UNIT III

HUMAN ORGAN SYSTEMS AND BIO DESIGNS (QUALITATIVE):

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). 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).

8 Hours

UNIT IV

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE):

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes-hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

8 Hours

UNIT V

TRENDS IN BIOENGINEERING (QUALITATIVE):

Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting 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, Bioimaging and Artificial Intelligence for disease diagnosis. Self- healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

8 Hours

TEXT BOOKS

1	Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao	Biology for Engineers, N Publishing, Bengaluru, 2023.
2	Stuart Fox, Krista Rompolski, McGraw-Hill	Human Physiology, 16th Edition, 2022
3	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.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Elucidate the basic biological concepts via relevant industrial applications and case studies.
CO2	Evaluate the principles of design and development, for exploring novel bioengineering projects.
CO3	Corroborate the concepts of biomimetics for specific requirements.
CO4	Think critically towards exploring innovative biobased solutions for socially relevant problems.

Web links and Video Lectures (e-Resources)
https://nptel.ac.in/courses/121106008
https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
https://www.coursera.org/courses?query=biology
https://onlinecourses.nptel.ac.in/noc19_ge31/preview
https://www.classcentral.com/subject/biology
https://www.futurelearn.com/courses/biology-basic-concepts

UNIVERSAL HUMAN VALUES

Contact Hours/ Week:	1+0+0 (L+T+P)	Credits:	1.0
Total Lecture Hours:	14	CIE Marks:	50
Total Tutorial Hours:	00	SEE Marks:	50
Total Practical Hours:	00	Exam Hours	3
Course Type	Theory (UHV)	Sub. Code:	SHS02

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. & Sangal R	'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore,

REFERENCE BOOKS		
1	Tripathi A.N	Human Values', New Age International Publisher, 2003

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	Have better critical ability in handling problems and in finding sustainable solutions

Ability Enhancement Courses - IV

ADVANCED TECHNICAL TRAINING – C++ LAB

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S4CCA02
Course Type:	Practical (AEC)	Exam Hours:	3

Course Outcomes:

Upon successful completion of this course, the student should 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.

#	*Modules Covered*	*Duration in hrs.*	
1	C Programming	15	
2	Data Structures	15	
3	C++ Programming	06	
	Total Course Duration	16 Hrs. Lecture	20 Hrs Practice

CIE: 50 Marks

- Students are accessed every class for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10 + 15+ 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of class assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50 Marks

There are 20 programs in the list divided into two parts A & B, students have to pick one program each from Part A & Part B.
Both the parts carry equal weightage.
Evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks.
Change of Experiment is allowed once in a first half an hour and in such cases evaluation is done for 80% of the Marks

Contents

• 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
a. Bubble Sort
a. Insertion Sort
a. Selection Sort
a. Merge Sort
a. Quick Sort
20. Tree
a. Pre-Order
a. In-Order
a. Post-Order
21. Graph
a. DFS
a. 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
a. Class and Object
a. Abstraction
a. Encapsulation
a. Inheritance
a. Polymorphism
a. Implementation of the OOPs Concepts

COMSOL MULTI-PHYSICS

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S4EIA02
Course Type:	Practical (AEC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1	Learn designing, setting up, executing and debugging various electronic circuits using simulation software.

(2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment **List of Experiments:**	
1.	Introduction to COMSOL Tree, Model Components, Component Couplings Geometry, Material, Physics, Mesh and Study, Solvers
2.	Introduction to AC/DC Module: Electrostatic, Electric currents and Magnetic Fields(2D/3D)
3.	Experiments to realize diode clipping and Clamping circuits.
4.	Experiment to Realize Half wave Rectifier
5.	Design and conduct Modelling of electric current interface using COMSOL
6.	Experiment to realize the electrical circuit using COMSOL Multiphysics
7.	Design and conduct Modelling of an AC electromagnet using COMSOL
8.	Design and static analysis of Cantilever beam using solid mechanics module
9.	Set-up and study effect of magnetic field due to solenoid
10.	Design and Multiphysics modeling of Piezoelectric transducer
11.	Design and analysis of Micropatterned Resistive Force Sensor
12.	Design an electrical stimulation for ARM Electrodes in Biomedical Application.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Design and simulate electronic circuits as per the specifications using discrete electronic components.
CO2	Perform predictions and optimize the modeled systems depending on the specifications.

ARDUINO UNO PROGRAMMING

Contact Hours/ Week:	0+0+2 (L+T+P)	Credits:	1
Total Lecture Hours:	0	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	28	Course Code:	S4EIA03
Course Type:	Practical (AEC)	Exam Hours:	3

Course objective: This course will enable students to:	
1.	Learn Arduino Uno / ESP32 Microcontroller programming
2.	Learn Interfacing of various I/O devices & communication modules

(2 Hours per week per batch) 13 Lab sessions + 1 Lab assessment **List of Experiments:**	
1.	Interfacing digital I/O devices.
2.	Timer function with digital I/O.
3.	Interfacing temperature sensor.
4.	PWM waveform generation.
5.	Interfacing serial communication devices.
6.	Interfacing stepper motor
7.	Interrupt in Arduino.
8.	I2C Communication.
Open ended Experiments (Only for CIE).	
9.	Transmission and reception of data through Bluetooth to a Mobile phone
10.	Automatic temperature control system – to switch on FAN if the temperature exceeds certain value.
11.	Temperature data acquisition and store in cloud server
12.	Case study in real time applications of Arduino

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Develop an algorithm to Interface digital and analog I/O devices to microcontroller
CO2	Develop an algorithm to Interface sensors & communication modules
CO3	Develop an algorithm for remotely monitor data and control devices.