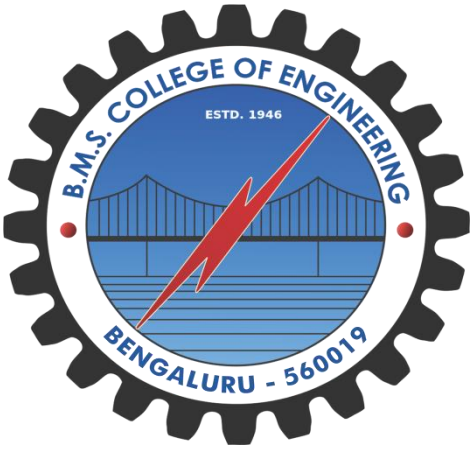

B.M.S. College of Engineering,

(Autonomous Institute)
Bull Temple Road, Bengaluru - 560019

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು
(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)
ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – ೫೬೦ ೦೧೯

Department of Electronics and Instrumentation Engineering

Scheme III to VIII Semester
Syllabus: III to IV Semester

2022 Batch

Institute Vision

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

Institute Mission

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

Department Vision

To bring forth globally emerging competent professionals with high quality of Technical Education who meet the demands of the modern industrial world which seeks innovation and continuous improvement in performance

Department Mission

- To accomplish excellence in curricular, co-curricular and R & D activities with active participation of students, faculty and staff.
- To impart quality education based on in-depth and thorough understanding of fundamentals.
- To prepare the students to meet the demands of the Electronics, Instrumentation industry.
- To Motivate and inspire young engineers to contribute to the development of the society

Program Educational Objectives

The Program Educational Objectives (PEOs) describe the professional accomplishments of our graduates about three-five years after having completed the under-graduate program in Electronics and Instrumentation Engineering. We describe the progress of our graduates through three PEOs. The first PEO reflects their professional career pursued through the knowledge acquired either as employees or as entrepreneurs, the second PEO is focussed on their desire to upgrade their technical skills, the third PEO describes their communication skills and team skills.

PEO 1	Excel in professional career in Electronics Engineering, Instrumentation Engineering and Allied industries.
PEO 2	Adapt to modern technological advancement by upgrading knowledge.
PEO 3	Exhibit leadership, team spirit and communication skills with a commitment towards the requirements of society.

Program Outcomes (POs)

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, are identical to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA), and are common across all branches of engineering. These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum, and help in the attainment of the PEOs.

PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognise the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

The Program Specific Outcomes (PSOs), are defined by the stakeholders of the program, and describe the skills in addition to the POs (defined by NBA), expected by the Electronics and Instrumentation Engineering student at the time of graduation. Similar to the POs, they are addressed through the outcomes of the courses, however, they are exclusive to the branch. The PSOs are developed through the teaching-learning process of various courses of the curriculum.

PSO 1	Graduate will apply the concepts of data acquisition, signal conditioning, control and communication in the field of Electronics and Instrumentation.
PSO 2	Graduate will simulate, analyse and interpret analog / digital circuit designs, related to applications of automation and control using modern engineering tools
PSO 3	Graduate will comprehend the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

Electronics and Instrumentation Engineering |2022

III Semester Scheme

Sl No	Course Type	Course Code	Course Title	Credits			Total Credits	Contact Hours	CIE	SEE	Total
				L	T	P					
1	BS	23MA3BSTFN	Transform Calculus, Fourier Series and Numerical Techniques	2	1	0	3	4	50	50	100
2	ES	23EI3ESLOI	Laser and Optical Instrumentation	3	0	0	3	3	50	50	100
		23EI3ESOPS	Operating Systems								
3	PC	23ES3PCAME	Analog Microelectronics (Common for MD, EIE)	3	0	1	4	5	50	50	100
4	PC	23ES3PCDEC	Digital Electronic Circuits (Common for EEE, ETE, MD, EIE)	3	0	1	4	5	50	50	100
5	PC	23ES3PCNAL	Network Analysis (Common for EEE, ECE, ETE, MD, EIE)	2	1	0	3	4	50	50	100
6	PC	23EI3PCSMT	Sensors and Measurements Techniques	2	0	1	3	3	50	50	100
7	BS	23ES3BSBFE	Biology for Engineers (Common for EEE, ECE, ETE, EIE)	1	0	0	1	1	25	25	50
8	AE	23EI3AECSP	Circuit Simulation and PCB	0	0	1	1	2	25	25	50
9	NCMC	23NCMC3NS1	NSS	0	0	0	0	2	-	-	-
		23NCMC3YG1	YOGA								
		23NCMC3PE1	Physical Education (Sports and Athletics)								
		TOTAL		**16**	**2**	**4**	**22**	**29**	**350**	**350**	**700**

Electronics and Instrumentation Engineering |2022

IV Semester Scheme

Sl No	Course Type	Course Code	Course Title	Credits			Total Credits	Contact Hours	CIE	SEE	Total
				L	T	P					
1	BS	23MA4BSCPS	Complex Analysis, Probability and Statistical Methods	2	1	0	3	4	50	50	100
2	ES	23ES4ESCST	Control Systems (Common for ECE, EIE, ETE)	2	1	0	3	4	50	50	100
3	PC	23ES4PCLIC	Linear Integrated Circuits (Common for MD,EIE)	3	0	1	4	5	50	50	100
4	PC	23ES4PCAPP	ARM Processor and Programming (Common for EEE, ECE, ETE, MD, EIE)	3	0	1	4	5	50	50	100
5	PC	23EI4PCTNI	Transducers and Instrumentation	2	0	1	3	4	50	50	100
6	PC	23EI4PCSAS	Signals and Systems	3	0	0	3	3	50	50	100
7	UHV	23MA4AEUHV	Universal Human Values	0	1	0	1	2	50	50	100
8	AE	23EI4AEDVI	Data Acquisition and Virtual Instrumentation	0	0	1	1	2	25	25	50
9	NCMC	23NCMC4NS2	NSS	0	0	0	0	2	-	-	-
		23NCMC4YG2	YOGA								
		23NCMC4PE2	Physical Education (Sports and Athletics)								
		TOTAL		**15**	**3**	**4**	**22**	**31**	**375**	**375**	**750**

III Semester

Course Title	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES (COMMON TO ALL BRANCHES EXCEPT CS-STREAM)				
Course Code	23MA3BSTFN	Credits	3	L-T-P	2-1-0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Engineering Mathematics, Analog Microelectronics, Signals and Systems.

MODULE -I — **8 Hours**

LAPLACE TRANSFORMS:

Definition and Laplace transform of standard functions (statements only). Problems on Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems.

Inverse Laplace transforms: definition and problems. Solution of differential equations.

MODULE -II — **8 Hours**

FOURIER SERIES:

Introduction to trigonometric polynomial, trigonometric series. Dirichlet's conditions. Fourier series of periodic functions with period 2π and arbitrary period. Complex Fourier series. Practical harmonic analysis.

MODULE -III — **8 Hours**

FOURIER TRANSFORMS:

Definition and problems on Fourier Transform. Fourier sine and cosine transforms – Problems.

Inverse Fourier transform, Inverse Fourier cosine and sine transforms - Problems. Convolution theorem (only statement) – problems.

MODULE -IV — **8 Hours**

NUMERICAL SOLUTION OF PDE:

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt and Bendre-Schmidt explicit formulae. Solution of one-dimensional wave equation using finite difference method.

MODULE -V — **8 Hours**

CALCULUS OF VARIATIONS:

Definition, Variation of a functional, Euler-Lagrange equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS:

Definition, Standard Z-transforms, Damping rule, Shifting rule. Inverse Z-transform and

applications – Solution of difference equations.	
Text books:	
1.	B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2.	E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.
Reference books:	
1.	B.V. Ramana: "Higher Engineering Mathematics", McGraw-Hill Education, 11th Ed.
2.	Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3.	N. P Bali and Manish Goyal: "A textbook of Engineering Mathematics", Laxmi Publications.
4.	C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics", McGraw–Hill Book Co. New York, 6th Edition.
5.	Gupta C.B, Sing S. R. and Mukesh Kumar: "Engineering Mathematics for Semester I and II", Mc-Graw Hill Education (India) Pvt. Ltd 2015.
6.	H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S. Chand Publication (2014).
7.	James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.
E-References	
1.	http://www.class-central.com/subject/math(MOOCs)
2.	http://academicearth.org/
4.	VTU e-Shikshana Program
5.	VTU EDUSAT Program
Internal choice: MODULE – I & V	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Apply the concepts of Series, Transform Techniques, Calculus of Variation and Finite Difference Methods to solve engineering problems.	
CO2: Apply the concepts of Transform Techniques, Calculus of Variation and Finite Difference Methods in engineering using modern IT tools.	

Course Title	LASER AND OPTICAL INSTRUMENTATION				
Course Code	23EI3ESLOI	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Physics, Basic Mathematics, Basic Electronics.

MODULE-I	8 Hours

Fundamentals of Laser, Types and Characteristics: Fundamentals of Laser, Characteristics of Laser, population inversion, three levels, four level laser, Principles, Classification and construction of Ruby, He-Ne, Nd-YAG, Semiconductor, Carbon dioxide lasers. Characteristics of stabilization, Q-switching and mode locking, frequency stabilization

MODULE-II	8 Hours

Laser Instrumentation: Measurement of distance - Interferometric methods, beam modulation telemetry, pulse echo techniques. Laser Doppler velocimetry- Holography-principle, applications of holography, holographic computer memories, laser welding, laser machining, laser printing and laser spectroscopy.

MODULE-III	8 Hours

Optical Fibers: Introduction to Optical Fibers, advantages and disadvantages of optical fibers. Principles of light propagation through a fiber Different types of optical fibers and their properties. Transmission characteristics of optical fiber –Absorption losses, Scattering losses Dispersion-intermodal dispersion, graded index fiber. Free Space Optics (FSO).

MODULE-IV	8 Hours

Optical Fiber Sensors: Introduction to optical sensor, Intensity modulated Fiber sensors- Fiber Optic Liquid level sensing, Optic micro bend sensor, Optic chemical sensing, Multimode passive and active fiber sensors, Fiber Optic current sensor, Fiber optic Gyroscope, Fiber Bragg gratings (FBGs) sensor.

MODULE-V	8 Hours

Fiber Optic Instrumentation: System Introduction, Fiber optic Mach-Zehnder Interferometer, Michelson Interferometer,optic Sagnac Interferometer, optic Fabry–Perot Interferometer-temperature, polarization fiber sensors, LiDAR for Autonomous vehicles.

Text Books:

1.	Optoelectronics and Fiber Optics Communication – C.K.Sarkar and D.C. Sarkar, New Age Int. Pvt. Ltd 2012.
2.	"Optical Sensors: Basics and Applications"Jörg Haus, Wiley-VCH, GmBH (2010).

Reference books:	
1.	J.Wilson&J F B Hawkes, Opto Electronics: An Introduction, Prentice Hall of India, (2011),3rd Ed.
2.	Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985.
3	"Fiber Optic Sensors Based on Plasmonics" B.D. Gupta, S.K. Srivastava and R. Verma, World Scientific Pub. Co. (2015).
E-References:	
1.	https://easyengineering.net/optoelectronics-an-introduction-by-john-wilson/
2.	https://www.sciencedirect.com/book/9780750653701/optoelectronics-and-fiber-optic-technology
3.	https://www.sciencedirect.com/book/9780125839617/industrial-applications-of-lasers
4.	https://www.routledgehandbooks.com/doi/10.1201/b17641-6
e–Learning :	
1.	https://nptel.ac.in/courses/117/101/117101002/
2.	https://nptel.ac.in/courses/115/107/115107122/
3.	https://archive.nptel.ac.in/courses/115/107/115107122/
Internal choice: Unit – I & III.	
Course outcomes **The course outcomes will be attained through theory and laboratory assessments.** At the end of the course, the student will have the ability to	
CO1: Apply the knowledge of engineering principles in Laser and optical fibre Instrumentation.	
CO2: Analyse the characteristics of Lasers in different applications.	
CO3: Comprehend the working of optical fibre sensors and detectors for measurement of various parameters.	
CO4: Assess the usability of the laser and optical fibre sensors in the fields of societal, health and safety issues.	

Course Title	OPERATING SYSTEMS				
Course Code	23EI3ESOPS	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basics of Computer Programming, Basic Electronics

MODULE-I	8 Hours

Introduction: Abstract view of operating system, Goals of an OS, Operation of an OS; **Overview of Operating System:** Efficiency, System Performance and User Convenience, Classes of operating systems: Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems.

MODULE -II	8 Hours

Scheduling: Preliminaries, Non-preemptive scheduling policies, Preemptive Scheduling policies, Real Time Scheduling

Process Management: Process- Process Concept, Process Scheduling Operations on Process

MODULE -III	8 Hours

Memory Management: Memory allocation process**,** Reuse of Memory, Contiguous Memory allocation, Non-Contiguous Memory Allocation

Virtual Memory : Virtual Memory Basics, **Demand Paging** – Overview of paging, Demand paging preliminaries, Page replacement ; Page Replacement Policies

MODULE -IV	8 Hours

Message Passing: Overview of message passing, Implementing message passing, Mailboxes

Deadlocks: Definition of deadlock, Deadlock in Resource Allocation, Handling Deadlocks, Deadlock Detection and Resolution, Deadlock Prevention, Deadlock Avoidance

MODULE -V	8 Hours

File System: File Concept, Access Methods, Directory Structure, File system Mounting; **Structure Of The Operating Systems:** Operation of an O.S, Structure of an operating system, Operating system with monolithic structure, layered design of operating system, Kernel based operating systems and Microkernel based operating systems.

Text books:

1	"Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH, 3rd Ed, 2012.
2	"Operating System Principles" , Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley, 7th Edition

Reference books:

1	Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education, 4th Ed, 2006
2	Modern Operating System - Andrew S Tanenbaum, Herbert Bos, Person Education, 4th Ed
E-References:	
1	https://www.techtarget.com/whatis/definition/operating-system-OS
2	https://www.oxfordreference.com/display/10.1093/oi/authority.20110810105527683
e–Learning :	
1	https://nptel.ac.in/courses/106108101
2	https://onlinecourses.nptel.ac.in/noc21_cs88/preview

Internal choice: MODULE – II & III

Course outcomes

At the end of the course, the student will have the ability to

CO1: Understand the basic components of an operating system.

CO2: Apply the knowledge of the components of computer and their respective roles in computing.

CO3: Design a control access to a computer and the files that may be shared.

CO4: Gain practical knowledge of how programming languages, operating systems, and architectures interact and how to use each effectively.

Course Title	**ANALOG MICROELECTRONICS**				
Course Code	**23ES3PCAME**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Basic concepts of Trigonometry, methods of differentiation, methods of integration, solution of ordinary differential equations.

MODULE I	**8 Hours**

Diode applications: Introduction, load line analysis, Series diode configurations, Parallel and series –parallel configurations ,

clippers , Clampers.

Bipolar Junction Transistor (BJTs):DC biasing– Introduction , operating point , voltage divider Bias configuration

BJT AC Analysis : Introduction , Application in the AC Domain, BJT Transistor Modeling, the r_e Transistor model ,Voltage Divider Bias .

MODULE II	8 Hours

BJT Frequency Response : Introduction, Logarithms, Decibels , Low frequency Response-BJT Amplifier, Miller effect Capacitance, High Frequency response – BJT Amplifier

Feedback concepts:- Feedback connection types- Voltage series, Voltage-shunt , Current Series and Current Shunt Feedback.

MODULE III	8 Hours

Power Amplifiers: Introduction- Definitions and Amplifier Types, Amplifier Efficiency

Series-Fed Class A Amplifier: DC Bias Operation, AC operation, Power Consideration, Efficiency.

Transformer coupled Class A Amplifier : Operation of Amplifier Stage : DC load line, Quiescent operating point, AC load line , Signal Swing and Output AC power.

Class B operation: Class B Amplifier Circuits- Transformer coupled Push- Pull Circuits, Complementary Symmetry Circuits, Amplifier Distortion.

MODULE IV	8 Hours

MOSFETS: Introduction,

Device structure and physical operation - Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the id – V_{DS} relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the sub-threshold region .

Current voltage Characteristics---Circuit symbol, id – V_{DS} characteristics, characteristics of the P-Channel MOSFET

MOSFET Circuits at DC

The MOSFET as an amplifier and as a switch --- Large – signal operation , Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.

Biasing in MOS amplifier circuits---Biasing by fixing V_{GS}, Biasing by fixing V_G and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source.

MODULE V	8 Hours

Small – signal operation and models of MOSFETs-The DC bias point, the signal current in the drain terminal ,the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the trans conductance g_m, the T equivalent circuit model.

Single stage MOS amplifiers-The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance.

Common gate (CG) Amplifier, The common Drain or source follower Amplifier.

CS Amplifier Frequency Response: High Frequency and Low frequency response.

Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation)

IC Biasing: – **Current sources, current mirror and current steering circuits---**

The basic MOSFET current source, MOS current steering circuits

Current mirror circuit with improved performance - The Wilson MOS mirror

Lab Experiments:

1. Diode and Transistor as a switch.
2. Diode clipping circuits- Single/Double ended
3. Diode clamping Circuits - positive clamping/negative clamping.
4. Design of Power supplies and regulators
5. BJT as RC coupled amplifier.
6. BJT as RC phase shift oscillator, Hartley , Collpits and Crystal Oscillator.
8. Power Amplifier.
9. MOSFET Characteristics
10. MOSFET Amplifier
11. Simulation Experiments.

* Open Ended Experiments using devices.

Text books:

1.	Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky-10th edition (PEARSON EDUCATION)
2.	Microelectronic Circuits-Theory and applications by Adel S. Sedra And Kenneth C.Smith Fifth Edition (Oxford International Student Edition

Reference books:

1.	Electronic Devices and Circuits, S. Salivahanan , N. Sereshkumar , McGraw Hill Education (India) Private Limited, ISBN -9781259051357
2.	Electronic Devices and Circuits- Millman and Halkias, TMH
3.	Electronic Devices and Circuits- David A Bell - PHI 4th edition

E-References

1.	https://www.mooc-list.com/ course/ electronic-systems-and-digital-electronics-uninettuno?static=true
2.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/

3.	Introductory Analog Electronics Laboratory (Spring 2007) by MIT open courseware Reviews and Ratings
e–Learning :	
1.	https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true
2.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/
Internal choice: MODULE – I & V	
Course outcomes At the end of the course on **Analog Microelectronics**, the student will have the ability to	
CO1: Apply the Network concepts to obtain solutions to analog electronic circuits of BJTs and MOSFETs.	
CO2: Analyse analog electronic circuits using BJTs and MOSFETs for given specifications.	
CO3: Design solutions of engineering problems and system components for the specific needs.	
CO4: Design and Conduct experiments by discrete components and Modern tools. Demonstrate, document and Present a report.	
CO5: Formulate and implement open ended experiment. Document and present the same in a Team	

Course Title	**DIGITAL ELECTRONIC CIRCUITS (Common for EEE, EIE, ETE and MD)**				
Course Code	**23ES3PCDEC**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
MODULE-I					**8 Hours**
Introduction: Review of Boolean algebra, logic gates. Simplification of Boolean functions: Three Variable, Four Variable and Five Variable K-Maps, The Tabulation Method, Design with Basic gates, NAND gates and NOR gates					
MODULE-II					**8 Hours**
Combinational Logic Circuits: Introduction, Parallel Adders (Carry Look Ahead Adder and Ripple carry adder), Decimal Adder, Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs).					
MODULE-III					**8 Hours**
Sequential Logic Circuits: The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-					

flops: Master Slave Flip-Flops, Edge Triggered Flip-Flops, Characteristic Equations, Conversion of flip-flops, Shift Registers, Ripple Counters, Synchronous Counters.

MODULE-IV	**8 Hours**

Sequential systems: Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations, Sequence detector.

MODULE-V	**8 Hours**

Logic Families:

Characteristic of Digital ICs, Transistor – Transistor Logic (NOT, NAND, NOR), Complementary MOS Logic (NOT, NAND, NOR), Comparison of TTL and CMOS families.

LAB Experiments:

1. Half/full adder and half subtractor using logic gates.
2. Parallel adder/subtractor and magnitude comparator using IC 7483
3. Applications using MUX
4. Applications using DEMUX
5. Code Converters
6. Decoder to Drive Seven Segment Display& Implementation of Priority Encoder
7. Flip-flops
8. Asynchronous Counters
9. Synchronous Counters
10. Shift registers

Alternate Assessment Test1: The topic will be announced in the first week of the semester. Using the concept's studied students are expected to design any system for a specific application- 5M.

Text books:

1.	Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education.
2.	Digital Principles and Design- Donald Givone, Tata McGraw Hill 3.

Reference books:

1.	Fundamental of Logic Design- Charles Roth Jr., Thomas Learning.
2.	Digital Logic Applications and principles- John Yarbrough, Pearson Education

E-References

1.	https://nptel.ac.in/courses/108105113/
2.	https://nptel.ac.in/courses/106105185/

e–Learning :

1.	https://www.panstanford.com/pdf/9789814364591fm.pdf
2.	https://easyengineering.net/digital-logic-and-computer-design-by-morris-mano/
3.	https://www.sciencedirect.com/book/9780750645829/digital-logic-design
4.	https://easyengineering.net/fundamentals-of-digital-circuits-by-anand-kumar/

Internal choice: MODULE – II & III

Course outcomes

At the end of the course, the student will have the ability to

CO1: Apply the knowledge of Boolean laws and Logic gates to simplify the given Boolean function

CO2: Analyze logic functions to reach optimized solution.

CO3: Design and Realize a digital circuit for a given specification.

CO4: Conduct experiments using digital ICs for a given problem statement.

CO5: Work individually/in a team to demonstrate an open-ended experiment and document the same.

Course Title	**NETWORK ANALYSIS (Common for EEE, ECE, EIE, ETE and MD)**				
Course Code	**23ES3PCNAL**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Basic KVL,KCL.

MODULE-I	**8 Hours**

Basic Concepts: Active and passive elements, ideal and practical sources. Source trans- formationand Source shifting, Super-Mesh and Super node analysis. Analysis of networks using star-delta transformation, Mesh and Node voltage methods for AC and DC circuits with independent and dependent sources, concept of Duality.

MODULE-II	**8 Hours**

Network Theorems: Super Position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

MODULE-III	**8 Hours**

Resonant Circuits: Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance

MODULE-IV	**8 Hours**

Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp and sinusoidal functions, LT of shifted functions, Waveform synthesis, Initial and Final value theorems,

Solutions for RL, RC networks for DC excitation. Transient Analysis: Transient analysis of RL and RC circuits under DC excitations: Behaviour of circuit elements under switching action (t = 0 and t = ∞), Evaluation of initial conditions.	
MODULE-V	**8 Hours**
Two Port Network and its Parameters: Definition, Open circuit impedance, short circuit admittance, hybrid and Transmission parameters. Relationship between different parameters.	
Unit Choice: MODUL -I and IV	
Text books:	
1.	"Network Analysis", Van Valkenburg M.E., Prentice Hall India, 2014.
2.	"Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, 8th Edition, 2014, TataMcGraw-Hill.
3.	"Circuit Theory Analysis and Synthesis", Chakrabarti, A., Dhanpat Rai & Co., 7th Revised Edition, 2018
Reference books:	
1.	"Network Analysis and Synthesis", Franklin F. Kuo, Wiley.
2.	"Analysis of Linear Systems", David K. Cheng, 11th reprint, 2002, Narosa PublishingHouse.
3.	"Network Analysis and Synthesis", Anand Kumar, 2019, PHI learning.
E-References	
1.	https://www.pdfdrive.com/introduction-to-electrical-circuit-analysis-e195167204.html
2.	https://www.vlab.co.in/
e–Learning :	
1.	http://elearning.vtu.ac.in/06ES34.html
2.	https://www.coursera.org/course/circuits
Internal choice: MODULE – I & IV	
Course outcomes	
CO1: Apply basic circuit laws and network theorems to linear electrical networks	
CO2: Analyze linear circuits in time and frequency domain	
CO3: Simulate linear circuits using appropriate tools	

Course Title	SENSORS AND MEASUREMENT TECHNIQUES				
Course Code	23EI3PCSMT	Credits	3	L-T-P	2:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basic Physics

MODULE-I	5 Hours

Measurements: Introduction, Significance of measurements, instruments and measurement systems, Functional elements of measurement system. Performance Characteristics of measuring instruments-Static & Dynamic. Measurement Errors: Gross and systematic.

Bridges: Wheatstone and Maxwell Bridges.

MODULE-II	5 Hours

Physical Principles of Sensing: Capacitance, magnetism, Induction, Resistance, Piezoelectric Effect, Hall effect, Thermoelectric effect, Sound waves, Temperature and thermal properties of materials

Displacement and Level Sensors: Inductive, Magnetic and Optical, Acceleration: Accelerometers Force and Strain: Strain Gauge, Pressure sensors.

MODULE-III	5 Hours

Acoustic sensor: Resistive and Fiber-optic microphones.

Humidity and Moisture sensor: Concept of Humidity, Thermal conductivity and Optical Hygrometers.

Radiation Detectors: Scintillating Detectors and Ionization Detectors

MODULE-IV	5 Hours

Temperature Sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, Optical Temperature sensors.

MODULE-V	5 Hours

Measuring Instruments: Interface Electronic Circuits, Signal conditioners, Sensor connections, excitation circuits, Data transmission, Noise in sensors and circuits, Battery for low power sensors.

Lab Experiments:

1. Conduct an experiment to Verify Resistance Temperature Detector, Thermistor and Thermocouple Characteristics
2. Conduct an experiment to measure displacement using Linear variable position transducer (LVDT)
3. Conduct an experiment to Measure Resistance using Wheatstone bridge and inductance

using Maxwell's Bridge.

4. Conduct an experiment on Light dependent resistor (LDR) rig up the circuit and verify its Characteristics.
5. Conduct an experiment to generate the voltage using piezo electric sensor
6. Conduct an experiment to Measure distance/displacement using capacitive transducer and also measure strain using strain gauge.
7. Use Virtual labs – Sensors Modeling and Simulation Lab, conduct the following experiments and generate the same.
   i) Characterise the temperature sensor (RTD) – Static and Dynamic Characteristics
   ii) Characterise the temperature sensor (Thermocouple)
   iii) Measurement of level in a tank using capacitive type level probe
   iv) Characterize the LVDT
   v) Characterize the Strain gauge sensor

Text books:	
1.	Measurement Systems, Ernest O Doebelin, Dhanesh N Manik, TMH, Sixth edition
2.	Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden , Sringer Publications, Fifth Edition (Chapter 1,4,5,6, 8,9,10,13,15,17,19)
Reference books:	
1.	"Electronics & Electrical Measurements", A K Sawhney, Dhanpat Rai & sons, 9th edition
2.	"Electronic 1Instrumentation and Measurements", David A Bell, PHI / Pearson Education,2006
E-References	
1.	https://electronicsforu.com/resources/7-free-instrumentation-engineering-ebooks
2.	https://www.azosensors.com/book-index.aspx
3.	https://doc.xdevs.com/doc/_Metrology/introduction-to-instrumentation-and-measurements-2-edition-byrobert-b-northrop.pdf
4.	http://www.realtechsupport.org/UB/SR/sensors/Fraden_Sensors_2010.pdf
5.	https://sl-coep.vlabs.ac.in/
e–Learning:	
1.	https://www.convergencetraining.com/measurement-methods-and-sensors-courses.html
2.	https://nptel.ac.in/courses/112103174/3
Internal choice: MODULE – II & III	

Course outcomes
At the end of the course the student will have the ability to
CO1: Apply the concepts of measurement systems to solve fundamental measuring engineering problems.
CO2: Integrate the knowledge of physics behind sensors and electronics conversion in a measurement system
CO3: Analyse the performance of measurement system and different types of sensor and its characteristics.
CO4: Conduct investigation to provide solution to specific measurement needs
CO5: Interpret the analog circuits for signal conditioning to the given circuit parameters.
CO6: Involve independently and use modern software tools to demonstrate concept of sensing and measuring system.

Course Title	**BIOLOGY FOR ENGINEERS (Common for EEE, ECE, ETE, EIE)**				
Course Code	**23ES3BSBFE**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
					15 Hours

Sensing Techniques: Understanding of Sense organs working-Sensing mechanisms - Sensor Devel- opment issues - Physiological Assist Device: Artificial Organ Development: Kidney, Liver, Pancreas, heart valves - Design Challenges and Technological developments.

Nature-bio-inspired mechanisms (qualitative): Echolocation (ultrasonography, sonars), Photosyn- thesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hy- drophobic and self-cleaning surfaces).

Bio printing techniques and materials: 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio imaging and Artificial Intelligence for disease diagnosis.

Introduction to Radiation: Source and Types of Radiation, Types of Ionizing Radiation, X-rays for Medical Use and Generators Types of Electromagnetic Waves, Ionization of Radiation - Property of Ionizing Radiation. Penetrating Power of Radiation within the Body, Penetrating Power and Range of Effects on the Human Body.

Radiation Effects on Human Body: Types of Effects, Exposure Modes and Effects Classification of Radiation Effects Deterministic Effects and Stochastic Effects, Mutation, Mechanism of Causing Effects on Human Body. Ionization due to Radiation, Damage and Repair of DNA. Radio

sensitivity of Organs and Tissues.	
Reference books:	
1.	"Human Physiology," Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2.	"Biology for Engineers", Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3.	"Biomedical Instrumentation", Leslie Cromwell, Prentice Hall 2011.
4.	"Biomimetics: Nature-Based Innovation", Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
5.	"Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", D. Floreano and C. Mattiussi, MIT Press, 2008.
6.	"3D Bioprinting: Fundamentals, Principles and Applications", Ibrahim Ozbolat, Academic Press, 2016
7.	"Electronic Noses and Tongues in Food Science", Maria Rodriguez Mende, Academic Press, 2016
E-References	
1.	VTU EDUSAT/SWAYAM/NPTEL/MOOCS/Coursera / MIT-open learning resource
2.	https://nptel.ac.in/courses/121106008
3.	https://freevideolectures.com/course/4877/nptel-biology-engineers-other -non-biologists
4.	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineeri ng-design-spring-2009
5.	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-0 10j-spring-2006
6.	https://www.coursera.org/courses?query=biology
7.	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8.	https://www.classcentral.com/subject/biology
9.	https://www.futurelearn.com/courses/biology-basic-concept
Course outcomes At the end of the course ,the student will have the ability to	
CO1: To understand biological concepts from an engineering perspective.	
CO2: To familiarize the concepts of biological sensing, bio printing techniques and materials , Role of Artificial Intelligence for disease diagnosis	
CO3: Understand the basics of radiation and its effects on Human Body	

Course Title	CIRCUIT SIMULATION AND PCB LAB				
Course Code	23EI3AECSP	Credits	1	L-T-P	0:0:1
CIE	50 Marks	SEE	50 Marks		

Lab Experiments:

SCILAB:

1. Simulation of transient response of RC circuit with voltage & current (in time domain) for different values of capacitor.
2. Simulation of transient response of RL circuit with voltage & current (in time domain) for different values of Inductor.
3. Simulation of step response of first order system for different values of capacitor.
4. Simulation of transient response of RLC network – second order (showing overdamped, under damped, critically damped and undamped waveforms)
5. Simulation of transient response of RC & RL circuit using XCOS for different values of capacitor.
6. Simulation of transient response of RLC circuit using XCOS (showing overdamped, under damped, critically damped and undamped waveforms)

PCB lab:

1. Transient response of RC & RL circuit using PSPICE for different values of capacitors.
2. Transient response of RLC circuit using PSPICE, (showing overdamped, under damped, critically damped and undamped waveforms)
3. Simulation for studying characterization of practical Battery Source in Single sweep, DC sweep and Parametric sweep
4. Simulation of Unregulated power supply with and without filter
5. Simulation of Regulated power supply using zener diode
6. Simulation of Regulated power supply using IC7805, IC7812
7. Simulation of Regulated power supply using IC7905, IC7912
8. Simulation of Dual power supply +/-5v or +/-12v
9. Simulation of Variable power supply using ICLM317K
10. Design and Simulation of Instrumentation Amplifier with inputs
    a. V1=10mv; V2=5mv
    b. V1=5mv; V2=10mv
    c. V1=10mv; V2=10mv
11. Design and Simulation of Instrumentation Amplifier whose input is taken from Wheatstone's bridge
12. Simulation of buck converter for LED lighting system and PCB prototyping.

Course outcomes

At the end of the course, the student will have the ability to

CO1: Apply working knowledge of SCILAB/Cadence tool package to simulate and solve electrical, electronic circuits and its applications.

CO2: Analyse the first and second order transient response of electric circuits using SCILAB.

CO3: Design basic electric and electronic circuits using cadence tool

CO4: Engage students in effective report writing.

IV Semester

Course Title	COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS (Common to AS/ME /EEE/ECE/ET/ CIVIL/EIE)				
Course Code	23MA4BSCPS	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites:

MODULE-I — **8 Hours**

COMPLEX ANALYSIS

Review of a function of a complex variable, limits, continuity and differentiability.

Analytic functions, Cauchy-Riemann equations in Cartesian and polar forms and consequences. Construction of analytic functions by Milne-Thomson method.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems. Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z}\ (z \neq 0)$.

MODULE-II — **8 Hours**

SPECIAL FUNCTIONS:

Introduction, Ordinary and Singular Points, Series solution of Bessel's differential equation leading to $J_n(x)$, Bessel's function of the first kind, Properties, generating function for $J_n(x)$. Series solution of Legendre's differential equation leading to $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) - Problems.

MODULE-III — **8 Hours**

STATISTICAL METHODS:

Curve Fitting: Fitting the straight line, parabola and geometric curve ($y = a\,x^b$) by the method of least squares.

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation. Lines of regression, angle between two regression lines.

MODULE-IV — **8 Hours**

PROBABILITY DISTRIBUTIONS

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Poisson and normal distributions.

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

MODULE-V	8 Hours

STATISTICAL Inference

Sampling Theory:

Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means (single mean and difference between two means), student's t-distribution (single mean and difference between two means), Chi-square distribution-goodness of fit.

Text books:

1.	Higher Engineering Mathematics, B. S. Grewal Khanna Publishers 44th Edition, 2017.
2.	Advanced Engineering Mathematics, E. Kreyszig: John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference books:

1.	Advanced Engineering Mathematics C. Ray Wylie, Louis C. Barrett McGraw-Hill, 6th Edition 1995.
2.	Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010.
3.	A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014.
4.	Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018.

E-References

1.	http://nptel.ac.in/courses.php?disciplineID=111
2.	http://www.class-central.com/subject/math(MOOCs)
3.	http://academicearth.org/
4.	http://www.bookstreet.in.
5.	VTU EDUSAT PROGRAMME – 20
6.	VTU e-Shikshana Program

Internal choice: MODULE – I & V

Course outcomes

At the end of the course ,the student will have the ability to

CO1: Apply the concepts of complex variables, special functions, probability and statistics to solve engineering problems.

CO2: Apply the concepts of complex variables, special functions and statistical methods using modern IT tools.

Course Title	CONTROL SYSTEMS (Common for ECE, EIE, ETE)				
Course Code	23ES4ESCST	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basic KVL, KCL

MODULE-I	8 Hours

Introduction: Examples of Control Systems, Open loop vs Closed loop Systems.

Mathematical Modelling of Linear Systems: Transfer functions, Transfer function of electrical circuits, Block diagram, Signal Flow graph.

MODULE-II	8 Hours

Time response analysis: Step response of first order, second order systems, response specification, steady state error and error constants.

MODULE-III	8 Hours

Stability Analysis: Concept of stability, R-H criterion, applications of R-H criterion with limitations. Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot.

MODULE-IV	8 Hours

Frequency response Analysis: Frequency domain specification, Polar plots, Nyquist plot, Stability Analysis

using Nyquist criterion, Bode plots, GM and PM, Stability Analysis using Bode Plot

MODULE-V	8 Hours

State Variable Analysis: Concept of state variables, physical variable model, phase variable model, obtaining transfer function from state model.

Text books:

1.	"Control Engineering" Nagrath and Gopal, New Age International Publishers.
2.	"Engineering Control Systems", Norman S. Nise, 5th Edition, John Wiley and Sons.

Reference books:

1.	"Modern Control Engineering", Ogata, Prentice Hall.
2.	"Automatic Control Systems", B. C. Kuo, John Wiley and Sons.

E-References

1.	http://en.wikibooks.org/wiki/Control_Systems
2.	http://www.electrical4u.com/control-system-closed-loop-open-loop-contr

e–Learning :

1.	http://elearning.vtu.ac.in/06ES34.html

2.	https://www.coursera.org/course/circuits

Internal choice: MODULE – III &IV

Course outcomes

At the end of the course ,the student will have the ability to

CO1: Apply the knowledge of engineering fundamentals to form mathematical model and obtain transfer function/state space representation of a system

CO2: Analyse the stability of LTI systems in time/frequency domain using different techniques

CO3: Design of LTI systems in time/frequency domain as a team/an individual

Course Title	**LINEAR INTEGRATED CIRCUITS (Common for MD, EIE)**				
Course Code	**23ES4PCLIC**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Pre Requisite: Basic concepts of analog electronic circuits and their analysis.

MODULE- I	**9 Hours**

Operational Amplifier Characteristics and Basic Applications : Introduction, Review of Differential Amplifiers, Internal Circuit and block diagram of Op-amp, DC and AC Characteristics – definitions, ideal and typical practical values. Basic Closed loop configurations and errors in practical circuits, Frequency Compensation. DC Applications: V to I, and I to V converters, Series Voltage regulator using Op-Amp. Instrumentation Amplifiers (IA), IA Chip – AD620. AC Applications: Precision half wave and full wave rectifiers, Sample and Hold circuits.

MODULE - II	**7 Hours**

Comparators and Waveform Generators: Introduction, Comparators, Inverting Schmitt Trigger, triangular waveform generator, Sinusoidal oscillators: RC phase-shift and Wien bridge oscillators. 555 Timer: Functional block diagram, Astable and Monostable Multivibrators using timer.

MODULE -III	**8 Hours**

Active Filters: Introduction, Classification of Filters. Active Filters: Design of First, Second and Fourth order Butterworth Low pass and high pass filters. All pass filters - Phase shift lead and lag types. Differentiator and Integrator Circuits: Ideal and Practical.

MODULE - IV	**8 Hours**

Data Converters: Introduction, Digital-to-analog converters (DAC): Specifications, basic DAC techniques-weighed resistor DAC, R-2R ladder DAC, and Inverted Ladder DAC.

Analog-to-digital Converters (ADC): Specifications, Types of ADCs - Counter type, Successive

Approximation, Dual slope, Flash, and Sigma – delta. Applications of DACs and ADCs. Introduction to Data Acquisition systems.

MODULE - V	**8 Hours**

Phase Locked Loops: Basic Principle, PLL Components: Analog and Digital Phase detectors, Voltage Controlled Oscillator VCO – SE566, Low Pass Filter. Applications of PLL in Frequency multiplication, division, and translation.

LAB Experiments:

List of Experiments: –

1. Inverting and non-inverting amplifier, voltage follower
2. Instrumentation Amplifier
3. Precision half wave and full wave rectifier
4. Voltage Comparators and Schmitt Trigger
5. Series Voltage Regulator using Op-Amp
6. Square waveform generator using 555 Timer
7. Triangular waveform Generator
8. RC- Phase shift and Wien bridge Oscillators
9. First and Second order low pass and high pass filters
10. Second Order Low pass filter
11. Data Acquisition Experiment

Alternate Assessment 1:- Open Ended Experiment

• The students will be required to form teams of sizes 2-4 and select an open-ended experiment in the analog domain.

• Topic Selection and approval: One working week after the 1st CIE.

• Final Evaluation: After the final CIE (Includes Demonstration, Presentation & Report Submission)

Text books:

1.	D.Roy Choudhury and Shail B.Jain, Linear Integrated Circuits, 4e, New Age International Publishers, 2010
2.	S.Salivahanan & V.S.Kanchana Bhaaskaran, Linear Integrated Circuits, 2e, McGraw - Hill Publication

Reference books:

1.	Ramakanth A.Gayakwad, Op-Amps and Linear Integrated Circuits,4th ed, PHI
2.	James M. Fiore, Op Amps and Linear Integrated Circuits- Concepts and Applications, Cengae Learning, 2011

E-References	
1.	https://swayam.gov.in/nd1_noc19_ee39/preview – op amp practical applications: design, simulation and implementation by Dr. Hardik J. Pandya , IISc Bangalore
2.	https://www.udemy.com/course/operational-amplifiers-linear-integrated-circuits/
3.	http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/
e–Learning :	
1.	https://web.mit.edu/6.101/www/reference/op_amps_everyone.pdf
2.	https://electronicsforu.com/resources/7-free-ebookstutorials-on-op-amp
3.	https://www.analog.com/en/education/education-library/tutorials/ analog-electronics.html

Internal choice: MODULE – I and IV

Course outcomes

At the end of the course, the student will have the ability to

CO1: Apply the knowledge of electronic engineering fundamentals to comprehend linear integrated circuit based systems.

CO2 : Analyze and interpret the effects of DC and AC limitations of Operational Amplifiers using the first principles of electronics.

CO3 : Design and develop analog sub-circuits for linear and non-linear applications in the areas of sourcing, signal - generation, conditioning, and communication.

CO4 : Conduct investigations by designing experiments and solutions for signal processing using digital-to-analog and analog-to-digital conversions.

CO5 : Experiment, document and present the test results of various applications of linear integrated circuits, and open-ended experiments, working both independently and in teams.

Course Title	**ARM PROCESSOR AND PROGRAMMING. (Common for EEE, ECE, ETE, MD, EIE)**				
Course Code	**23ES4PCAPP**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Digital Electronic Circuits					
MODULE-I				**8 Hours**	
ARM Processor fundamentals –Basic Structure of computers- Von Neumann and Harvard Architecture,, Basic Processing Unit, Bus Structure, RISC and CISC Architecture, RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating					

modes, ARM pipeline	
MODULE-II	**8 Hours**
ARM Assembly Programming: load/store architecture, ARM instruction set, Assembler rules and Directives, ARM-THUMB interworking, Assembly Language Programs	
MODULE-III	**8 Hours**
Embedded C Programming Basic C data types, Local variable types, C compiler, Optimization; C looping and structures, Registrar allocation, function calls, Writing and optimizing assembly codes, mixing C and Assembly programming, Instruction scheduling.	
MODULE-IV	**8 Hours**
Subroutines and stacks-introduction, stack, subroutines, passing parameters to Subroutines, Exception and interrupt handling- Vector Table, Exception priorities, link register offsets, interrupts. Interrupt handling schemes-Non Nested	
MODULE-V	**8 Hours**
Application of ARM controller LPC 2148: Memory map, memory and I/O mapped peripherals, ADC, DAC and UART-Interfacing Programs, firmware and boot loader, introduction to Embedded Operating System	
Lab Experiments: 1. Divide an 8-bit variable into two 4 bit nibbles and store one nibble in each byte of a 16 bit variable. Store the disassembled byte in memory location (pointed by result) 2. Compare 2 values stored in memory location and store the higher value in a memory location (pointed by result) 3. Write a program to add two 64-bit numbers and store the result in a memory location. 4. Add a series of 16-bit numbers stored in sequential location in memory (called Table)and store the result in memory 5. Find the factorial of a given number 6. Write an assembly language program using the ARM instruction set to find the largest in a series of numbers stored in memory. Store the largest number in a memory location 7. ALP to multiply two 16 bit binary numbers. 8. ALP to find the sum of first 10 integer numbers. 9. Write a program in C for the ARM processor to read data from the 8-bit on board DIP switch and display the value on the 8 LEDs 10. Write a program in C for the ARM processor to use the built in DAC to generate the following	

waveforms - square, ramp, triangle and sine 11. Write a program in C for the ARM processor to rotate the stepper motor in both directions. 12. Establish serial communication between the ARM kit and the PC and do the following: Send a character from the ARM kit to the serial terminal on the PC Send a character from the PC to the ARM Kit and display it on the LED, Send a character from the PC to the ARM Kit. The program on the ARM processor should add 2 to it and send it back to the PC	
Text books:	
1.	ARM System Developer's Guide, Sloss, Symes, WrightMorgan Kaufmann Publishers, Elsevier,2005
2.	ARM Assembly Language- Fundamentals and Techniques, William Hohl, CRC press, Taylor and Frncis,2009
Reference books:	
1.	Computer Organisation & Architecture , William Stallings, PHI , 2010
2.	ARM System –on-Chip Architecture , Steve Furber, Seocnd Edition, Pearson, 2010
3.	D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991
E- References:	
1	https://www.pdfdrive.com/embedded-systems-introduction-to-arm-cortextm-m-microcontrollers-e176014882.html
2	https://www.pdfdrive.com/arm-microprocessor-systems-cortex-m-architecture-programming-and-interfacing-e157100364.html
e–Learning :	
1	https://onlinecourses.nptel.ac.in/noc20_cs15
2	https://nptel.ac.in/courses/117106111
	Internal choice: MODULE – II and III
Course outcomes At the end of the course, the student will have the ability to	
CO1: Apply knowledge of functional blocks of computers in recognizing ARM Design approach.	
CO2: Analyse the Architectural features of 32-bit microprocessor with necessary Input/Output and Memory Operations to build an embedded Controller.	
CO3: Design simple programming modules in machine and higher-level programming language using simulators to develop logical skills and testing skills	
CO4: Select and implement appropriate Structured and modular programming using techniques	

such as subroutines, data stores, interrupt service routines and exception handling mechanisms
CO5: Build simple Embedded Applications using Input and output devices with ARM core and a controller

Course Title	**TRANSDUCERS AND INSTRUMENTATION**				
Course Code	**23EI4PCTNI**	**Credits**	**3**	**L-T-P**	**2:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Sensors and Measurement					
MODULE-I					**8 Hours**
Introduction to Sensor based Measurement System General concepts and terminologies, IO Configuration, Classification, Measurements of moisture, viscosity, speed and vibration. Materials for sensors, Applications of Sensors.					
MODULE-II					**8 Hours**
Flow Measurement Purpose of measuring Flow, Newtonian and non-Newtonian Fluids, Reynolds's number, Laminar and turbulent flows, Velocity profile, Bernoulli's equation for incompressible flow. Variable head type flow meters, Orifice plate, Venturi tube, Flow nozzle, Pitot tube. Variable area type: Rotameter, Other Flow meters: Turbine, Electromagnetic, Ultrasonic (Doppler, Transit time i.e. Cross correlation, Anemometers).					
MODULE-III					**8 Hours**
Temperature Measurement Temperature Scales: Units and relations, Classification of temperature Sensors, Mechanical: Bimetallic Thermometer. Resistance type temperature sensors, Resistance Temperature Detectors - Types and comparison, Circuits for lead wire compensation, thermistors (principle, types & characteristics and Measuring Circuits). Thermocouple: Terminology, Types (J, K, R, S, T), Characteristics, Laws of thermoelectricity, Study of thermocouple tables, Cold junction compensation techniques, Protection (Thermo well), Thermopiles. Applications.					
MODULE-IV					**8 Hours**
Pressure Measurement Units of pressure –pressure transducers and its working, Manometers, Different types – Elastic type pressure gauges – Bourdon type- Bellows, capsules, diaphragms, Measurement of vacuum – McLeod gauge. Performance and installation criteria of pressure transmitter, Comparison of different types of pressure transmitters, Smart pressure transmitters and their calibration, Dead weight tester.					

MODULE-V	8 Hours

IoT and its application

Internet of Things, IoT Conceptual Framework, IoT Architectural view, Technology behind IoT, Sources of IoT, M2M Commination, Examples of IoT, IoT Case studies: Smart home, Cities, Environment monitoring and Agriculture.

LAB Experiments:

1. To Study the characteristics of Resistance Temperature Detector (RTD) and design the signal conditioning circuit suitable for controller.
2. To Study the characteristic of Thermocouple by varying Temperature and design the signal conditioning circuit suitable for controller.
3. To Study the characteristic of Thermistor with respect to Temperature and design the signal conditioning circuit suitable for controller
4. Measurement of unknown Resistance using a Wheatstone bridge.
5. To Study the characteristics of load cell and its application using Load cell.
6. To Study the characteristics of LDR and its applications.

IOT and Sensors –Virtual lab

7. Characteristics for LVDT
8. Characterize the strain gauge sensor
9. Flow Through Pipes
10. Design an Orifice plate for a typical application
11. Flow measurement by orificemeter and venturimeter

To find the coefficient of discharge for venturi meter.

To find the coefficient of discharge for orifice meter.

Text books:

1.	Bela .G. Liptak, Process Measurement and Analysis– Hand Book Fourth Edition
2.	N.E. Battikha, The condensed handbook of measurement and control, 4th Edition, ISA, 2018
3.	Internet of Things-Architecture and Design Principles, Raj Kamal, McGraw Hill Education

Reference books:

1.	Jacob Fraden, Handbook of Modern sensors, physics design and applications, Springer, Fourth edition.
2.	Instrument transducers, H.K.P. Neubert, Oxford University press
3.	Ernest O. Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.

4.	D. Patranabis, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill Education, 2008
E-References	
1.	https://physicsinstrumentation.files.wordpress.com/2015/03/measurement_systems_application_design.pdf
2.	https://global.oup.com/academic/product/electronicinstrumentation-and-measurements-9780968370520?q=Electronic%20Instrumentation%20and%20Measurements&lang=en&cc=in3.
e–Learning :	
1.	https://nptel.ac.in/courses/108/105/108105064/
2.	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/
3.	https://www.youtube.com/watch?v=q8UuRkOQ9A0
Internal choice: MODULE – II & IV	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand the functional elements of sensing and transduction principles of various types of transducer/sensors.	
CO2: Impart the basic concepts of fluid flow.	
CO3: Illustrate the principle, design and working of transducers for the measurement of displacement, strain and temperature.	
CO4: Investigate to provide solutions to industrial processes & process in pressure measurement.	
CO5: Engage student individually/ in a team to demonstrate sensing and transducers Systems and document the same.	

Course Title	**SIGNALS AND SYSTEMS**				
Course Code	**23EI4PCSAS**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
MODULE-I					**8 Hours**
Signals and their representation: Real life examples of signals, Signals-continuous and discrete time signals representation, Classification of Signals-Even and odd signals, deterministic and random signals, periodic and non-periodic signals, energy and power signals, elementary continuous and					

discrete time signals, relationship between step, impulse and ramp signals. Problems

Basic Operations on Signals: Operations performed on the dependent variables-amplitude scaling, addition, multiplication, differentiation and integration. Operation performed on independent Variable-time scaling, time delay and time folding, precedence rule, Problems.

Note: Continuous and discrete Signals representation, basic operations on signals using software like MATLAB/Scilab

MODULE-II	**8 Hours**

Systems: Real life examples of systems**,** Continuous time and discrete time Systems, classification of systems (for continuous and discrete time systems) -Linear and non-linear systems, Causal and non-causal systems, time-invariant and time variant systems, static and dynamic systems, stable and unstable systems using BIBO concept, invertible and inverse systems. System Viewed as Interconnection of Operations. Problems.

MODULE-III	**8 Hours**

Time domain representations of Linear Time Invariant Systems: Introduction: Impulse response representation of LTI systems-continuous time (convolution integral) and discrete time systems (convolution sum). Problems.

Properties of impulse response representation of LTI systems-continuous time and discrete time systems, Unit step response of an LTI system. Differential and Difference equation representation for LTI systems, Problems-natural response, forced and total/complete response. Basic building blocks or elements representation of Continuous time and discrete time system, Problems.

MODULE-IV	**8 Hours**

Fourier Representation for signals: Continuous time and Discrete Time Fourier Series representation of periodic and non-periodic signals, Properties of DTFS, CTFT and DTFT proofs, magnitude and phase spectra and problems.

Frequency response of LTI Systems: Impulse response, solution of differential and difference equations. Fourier transform representation for periodic signals, Convolution and Modulation with Mixed Signal classes, Sampling.

MODULE-V	**8 Hours**

Z-transforms: Z-transform of a sequence and Region of convergence(single sided and two sided Z-transform)**,** properties, Inverse Z-transform-partial fraction method and long division or power series expansion method, Problems.

Transform Analysis of LTI Systems using Z-transform, Relating the transfer function and difference equation, Causality and stability, Inverse Systems, Unilateral Z-transforms and solution of difference

equations. Problems. Realization of Discrete Systems: Structural realization of discrete systems – Direct form– I, Direct form-II, Cascade and parallel forms.	
Text books:	
1.	Simon Haykin and BarryVan Veen "Signals and Systems", John Wiley & Sons, 2001, Reprint 2002.
2.	Alan V Oppenheim, Alam.S, Willsky A Hamid Nawab, "Signals and Systems", Pearson Education Asia PHI, 2nd edition, 1997, Indian Reprint 2002.
Reference books:	
1.	H.P.Hsu, R.Ramjan, Signals and Systems", Scham's outlines,TMH, 2006
2.	B.P.Lathi, " Linear Systems and Signals", Oxford University Press, 2005.
3.	Ganesh Rao and Satish Tunga, " Signals and Systems",Sanguine Tech 2004.
4.	Michael Roberts, "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
E-References	
1.	https://nptel.ac.in/courses/117101055
e–Learning :	
1.	NPTEL lecture video on Signals and Systems by Roy https://www.youtube.com/watch?v=h-CdTxDShho&list=PLC6210462711083C4&index=1
2.	Principles of Signals and Systems By Prof. Aditya K. Jagannatham, IIT Kanpur https://archive.nptel.ac.in/courses/108/104/108104100/
3.	NPTEL lecture video by Dr.Kushal Shah, IISER,-Bhopal https://archive.nptel.ac.in/courses/108/106/108106163/
4.	NPTEL lecture video by Signals and Systems, IIT Kanpur Prof. K.S. Venkatesh https://nptel.ac.in/courses/117104074
Internal choice: MODULE – I & II	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understanding of fundamental concepts and terminologies related to signals and systems.	
CO2: Apply mathematical techniques to analyze continuous-time and discrete-time signals.	
CO3: Apply transform techniques to address engineering problems involving differential equations and difference equations.	

CO4: Analyze linear time-invariant (LTI) systems in both time and frequency domains.
CO5: Apply Z-transform techniques to analyze and solve problems involving discrete-time signals and systems.
CO6: Investigate using open source software to model continuous and discrete time systems.

Course Title	**UNIVERSAL HUMAN VALUES**				
Course Code	**23MA4AEUHV**	**Credits**	**1**	**L-T-P**	**0:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					

MODULE-I	**3 Hours**

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE-II	**3 Hours**

Understanding Harmony in the Human Being - Harmony in Myself! 1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of 'I' and harmony in 'I' 5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

MODULE-III	**3 Hours**

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship 1. 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 2. Understanding the meaning of Trust; Difference between intention and competence 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Orderfrom family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives	
MODULE-IV	**3 Hours**
Understanding Harmony in the Nature and Existence - Whole existence as Coexistence 1. Understanding the harmony in the Nature 2. Holistic perception of harmony at all levels of existence	
MODULE-V	**3 Hours**
Implications of the above Holistic Understanding of Harmony on Professional Ethics: 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc	
Text books:	
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
Reference books:	
1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book).
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.	Small is Beautiful - E. F Schumacher
6.	Slow is Beautiful - Cecile Andrews
7.	Economy of Permanence - J C Kumarappa
8.	Bharat Mein Angreji Raj – PanditSunderlal
9.	Rediscovering India - by Dharampal
10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11.	India Wins Freedom - Maulana Abdul Kalam Azad

12.	Vivekananda - Romain Rolland (English)

Course outcomes

At the end of the course ,the student will have the ability to

CO1: Conduct self-exploration and distinguish between values and skills, happiness and accumulation of physical facilities, the self and the body, Intension and Competence of an individual

CO2: Analyze the value of harmonious relationship based on trust and respect in personal and professional life

CO3: Examine the role of a human being in ensuring harmony in society and nature

CO4: Apply the understanding of ethics in life and profession

Course Title	**DATA ACQUISITION AND VIRTUAL INSTRUMENTATION**				
Course Code	**23EI4AEDVI**	**Credits**	**1**	**L-T-P**	**0:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Lab experiments

1. **Development of basic algorithms in LabVIEW and design of Graphical user Interface(GUI)**

2. **Development of Sub VI** a) Half adder design and designing full adder using Half adder Sub-VI. b) Design 8:1 mux using 2:1 mux Sub-VI.

3. **Usage of structures in LabVIEW**- For loop, While loop, Case structures, Sequence structures-flat and stacked, event structures

4. **Development of algorithms using Arrays and clusters function pallets** a) Create a 1-D numeric array and check whether the array elements are odd or even and in the output display 0 and 1respectively. b) To find the sum of positive and negative numbers in a given array. c) Build a VI that generates 1-D array and sort array in ascending and descending order. Also find the maximum and minimum number, size of array. d) Create a 2-D array and find the sum of rows and columns separately and display.

5. **String and File Input and output operations using LabVIEW** a) Build a VI which finds the number of occurrence of particular string in an array of strings. b) Build a VI to find whether the input string is a palindrome or not. c) Build a VI to split numbers and words available in a string and display the split numbers and words in separate array. d) Create a table of username and password. Input a username and password, if match is found display ACCESS GIVEN else ACCESS DENIED.

6. **Data Acquisition from various sensors using DAQ Cards: -** Finite and continuous buffered acquisition modes, Analog input, digital input, digital output and analog outpu.

7. **Control simulation tool box:** Building a VI to simulate and study the performance of First order and second order systems.

8. **Generation of HTML report** using LabVIEW

9. **Signal processing :** Different wave generation and detection.

9. **Case study:** Acquire, analyze and present an ECG signal using Virtual Instrumentation and also implementing an algorithm to calculate its heart rate.

Text books:

1.	"LabVIEW for Everyone" JEFFREY TRAVIS JIM KRING, 3rd Edition, Pearson education.
2.	"Virtual Instrumentation, LABVIEW", Sanjay Gupta, TMH, NewDelhi,2003
3.	"PC Interfacing for Data Acquisition and Process Control",S.Gupta andJPGupta InstrumentSocietyofAmerica,1994

Course outcomes

At the end of the course ,the student will have the ability to

CO1: Apply the knowledge of LabVIEW programming for simulating and analyzing the data.

CO2: Create applications that uses plug in DAQ boards and built in analysis functions to process the data.

CO3: Designing application using tools available in LabVIEW through an open ended experiment.

CO4: Engage in report making, independent and team learning.