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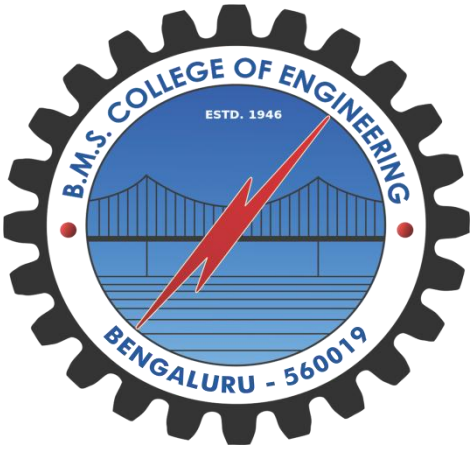

B.M.S. College of Engineering,
(Autonomous Institute)
Bull Temple Road, Bengaluru - 560019

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 VI 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.

Distribution of credits among various Curricular Components

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course (BS)	8	8	4	3					**23**
Engineering Science Course (ES)	9	9	3	3					**24**
Professional Core Course (PC)			14	14	14	11	6		**59**
Professional Elective Course (PE)					3	3	3	3	**12**
Open Elective Course (OE)						3	3	3	**9**
Project/ Mini-Project (PW)					2	2	8		**12**
Internship (Re/Ru/In)								6	**6**
Humanities and Social Sciences, Management Course (HS)	1	1			3 (EVS PMF)				**5**
Ability Enhancement Course /SDC	2	2	1	1		3 (RMI PLC)			**9**
UHV Courses (AE)				1					**1**
Non-Credit Mandatory Course	-	-	NC	NC	NC	NC	-	-	**4 Modules**
Total Credits	**20**	**20**	**22**	**22**	**22**	**22**	**20**	**12**	**160**

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	50	50	100
8	AE	23EI3AECSP	Circuit Simulation and PCB	0	0	1	1	2	50	50	100
9	NCMC	23NCMC3NS1	NSS	0	0	0	0	2	-	-	-
		23NCMC3YG1	YOGA								
		23NCMC3PE1	Physical Education (Sports and Athletics)								
TOTAL				**16**	**2**	**4**	**22**	**29**	**400**	**400**	**800**

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	50	50	100
9	NCMC	23NCMC4NS2	NSS	0	0	0	0	2	-	-	-
		23NCMC4YG2	YOGA								
		23NCMC4PE2	Physical Education (Sports and Athletics)								
TOTAL				**15**	**3**	**4**	**22**	**31**	**400**	**400**	**800**

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V Semester Scheme

Sl. No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours	Marks		
				L	T	P			CIE	SEE	Total
1	PC	23EI5PCCST	Communication Systems	2	0	0	2	2	50	50	100
2	PC	23EI5PCPCS	Process Control Systems	3	0	1	4	5	50	50	100
3	PC	23EI5PCVLI	Basic VLSI Design	3	0	1	4	5	50	50	100
4	PC	23EI5PCDSA	Digital Signal Processing and its Applications	3	1	0	4	5	50	50	100
5	HS	23CV5HSEVS	Environmental Studies	1	0	0	1	1	50	50	100
6	PE	23EI5PE1XX	Professional Elective -1	3	0	0	3	3	50	50	100
7	PW	23EI5PWMPR	Mini Project	0	0	2	2	4	50	50	100
8	HS	23ES5HSPMF	Project Management and Finance	2	0	0	2	2	50	50	100
9	NCMC	23NCMC5NS3	NSS	0	0	0	0	2	-	-	P/NP
		23NCMC5YG3	Yoga								
		23NCMC5PE3	Physical Education								
			Details of 40 AICTE Activity Points								
TOTAL				**17**	**1**	**4**	**22**	**29**	**400**	**400**	**800**

Code	Professional Elective -1
23EI5PE1DS	Digital System Design
23EI5PE1PI	Industrial Process Instrumentation
23EI5PE1SE	Sensor Analytics and Edge Devices
23EI5PE1CD	C++ and Data Structures

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VI Semester Scheme

Sl. No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours	Marks		
				L	T	P			CIE	SEE	Total
1	PC	23EI6PCPSA	Process Automation	2	1	0	3	4	50	50	100
2	PC	23EI6PCIDS	Industrial Data Networks and Safety	3	0	1	4	5	50	50	100
3	PC	23EI6PCESD	Embedded System Design	3	0	1	4	5	50	50	100
4	AE	23ES6AERMI	Research Methodology and IPR	2	0	0	2	2	50	50	100
5	PE	23EI6PE2XX	Professional Elective -2	3	0	0	3	3	50	50	100
6	OE	23EI6OE1XX	Open Elective -1	3	0	0	3	3	50	50	100
7	PW	23EI6PWPJ1	Project Work -1	0	0	2	2	4	50	50	100
8	AE	23EI6AEPLC	PLC Programming & SCADA	0	0	1	1	2	50	50	100
9	NCMC	23NCMC6NS4	NSS	0	0	0	0	2	-	-	P/NP
		23NCMC6YG4	Yoga								
		23NCMC6PE4	Physical Education								
			Details of 60 AICTE Activity Points Earned								
TOTAL				**16**	**1**	**5**	**22**	**30**	**400**	**400**	**800**

Professional Elective -2		Open Elective -1	
Code	**Course Title**	**Code**	**Course Title**
23EI6PE2BI	Biomedical Instrumentation	23EI6OE1CI	Carbon Initiative for Climate
23EI6PE2II	Industrial Internet of Things	23EI6OE1HD	Fundamentals of HDL
23EI6PE2DP	Digital Image Processing	23EI6OE1PD	PCB Design
23EI6PE2AM	Artificial Intelligence and Machine Learning	23EI6OE1IS	Industrial Safety and Standards

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VII Semester Scheme

Sl. No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours	Marks		
				L	T	P			CIE	SEE	Total
1	PC	23EI7PCGAP	5G and its Applications	2	0	1	3	4	50	50	100
2	PC	23EI7PCSSC	Sustainable Solutions for Smart Cities	2	0	0	2	2	50	50	100
3	PC	23EI7PCTRA	Technological Trends in Automation	1	0	0	1	1	50	50	100
4	PE	23EI5PE3XX	Professional Elective -3	3	0	0	3	3	50	50	100
5	OE	23EI7OE2XX	Open Elective -2	3	0	0	3	3	50	50	100
6	PW	23EI7PWPJ2	Project work-2	0	0	8	6	16	50	50	100
			Details of 80 AICTE Activity Points Earned								
TOTAL				**11**	**0**	**9**	**20**	**29**	**300**	**300**	**600**

Professional Elective -3		Open Elective -2	
Code	**Course Title**	**Code**	**Course Title**
23EI7PE3AE	Automotive Electronics	23EI7OE2GE	Green Electronics
23EI7PE3CV	Computer Vision	23EI7OE2GB	Green Building Technologies
23EI7PE3RA	Robotics and Automation	23EI7OE2FA	Food and Agriculture Instrumentation
23EI7PE3MD	Dynamic System Modelling	23EI7OE2MT	MEMS technology

VIII Semester Scheme

Sl. No.	Course Type	Code	Course Title	Credits			Total Credits	Total Hours	Marks		
				L	T	P			CIE	SEE	Total
1	PE	23EI8PE4XX	Professional Elective -4	3	0	0	3	3	50	50	100
2	OE	23EI8OE3XX	Open Elective -3	3	0	0	3	3	50	50	100
3	INT	23EI8SRINT	Internship	0	0	6	6	12	50	50	100
			Details of 100 AICTE Activity Points Earned								
TOTAL				**6**	**0**	**6**	**12**	**18**	**150**	**150**	**300**

Professional Elective -4		Open Elective -3	
Code	**Course Title**	**Code**	**Course Title**
23EI8PE4AN	Analytical Instrumentation	23EI8OE3AE	Automotive Electronics
23EI8PE4CS	Cyber Security	23EI8OE3IS	Instrumentation for Connected Cities
23EI8PE4DS	Data Science	23EI8OE3WT	Wearable Technologies
23EI8PE4DL	Deep Learning	23EI8OE3ST	Smart Sensors technologies for IoT

Internship shall be carried for (16-20 weeks) out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes

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 & IV.	
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 $t = \infty$), Evaluation of initial conditions.

MODULE-V	**8 Hours**

Two Port Network and its Parameters:

Definition, Open circuit impedance, short circuitadmittance, 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 Development 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.	

V Semester

Course Title	COMMUNICATION SYSTEMS				
Course Code	23EI5PCCST	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Pre-requisites: Engineering Mathematics, Signals and Systems.

MODULE -I	**5 Hours**

Amplitude Modulation:

Generation of AM waves, Detection of AM waves, Generation of DSBSC waves, Coherent Detection of DSBSC Modulated waves. Costas receiver, Quadrature Carrier multiplexing.

MODULE -II	**5 Hours**

Angle Modulation:

Basic Concepts, Relationship between PM and FM Waves, Narrow-Band Frequency Modulation (NBFM), Wide-Band Frequency Modulation (WBFM), Generation of FM waves using direct FM, demodulation of FM waves, frequency discriminator, comparison of AM and FM.

MODULE -III	**5 Hours**

Noise in Analog Modulation Systems:

Signal-to-noise ratios, noise in AM receivers using envelope detection, FM receiver model, noise in FM receiver, Pre-emphasis and De-emphasis in FM systems.

MODULE -IV	**5 Hours**

Sampling Process, Pulse-Amplitude Modulation (PAM), Pulse-Position Modulation, Quantization Process, Pulse-Code Modulation (PCM), delta Modulation, Differential Pulse-Code Modulation.

MODULE -V	**5 Hours**

Digital Modulation:

Binary Amplitude-Shift Keying, Phase-Shift Keying, Frequency-Shift Keying, QPSK transmitter and receiver, signal-space representation, Introduction to concept of FDMA, TDMA, CDMA.

Simulation Experiments:

AM modulator and Demodulator, DSB-SC modulator and Demodulator, FM modulator and Demodulator, PAM modulator and Demodulator, BPSK & QPSK.

Text books:

1.	Communication Systems, 5th Edition, Michael Moher, Simon Haykin, ISBN: 978-1-118-07296-7, January 2021
2.	An Introduction to Analog and Digital Communications, 2nd Edition, Michael Moher, Simon Haykin, ISBN: 978-1-118-31310-7, April 2012.

Reference books:

1.	Digital Communication Systems, 1st Edition, Simon Haykin, ISBN: 978-1-118-54405-1 January 2013.
2.	Communication Systems, 5ed, ISV, An Indian Adaptation, Simon Haykin, Michael Moher, Ajay Singh Raghuvanshi, Shweta Shah, 5 August 2022.
3.	Electronic Communication System, George Kennedy, Bernard Davis, S. R. M Prasanna, November 2017.
E-References	
1.	https://www.wiley.com/en-us/Communication+Systems%2C+5th+Edition-p-9781118072967
2.	https://gctjaipur.wordpress.com/wp-content/uploads/2015/08/an-introduction-to-analog-and-digital-communications-2nd-edition.pdf
e–Learning :	
1.	http://nptel.ac.in/courses/117102059/
2.	https://archive.nptel.ac.in/courses/108/104/108104091/
Internal choice: MODULE I & V	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Apply the concept of modulation and demodulation in AM & FM system.	
CO2: Analyse the various parameters in analog and digital communication system.	
CO3: Design the different digital modulation and demodulation systems.	
CO4: Simulate the modulator and demodulator for the given analog /digital communication system using modern tools.	

Course Title	**PROCESS CONTROL SYSTEMS**				
Course Code	**23EI5PCPCS**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks(50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Linear Integrated Circuits					
MODULE-I					**8 Hours**
Introduction to Process Control: Introduction, Types of processes, Process Control- principles, block diagram representation of Process control systems, Control systems evaluation, sensor time response,					

Analog and Digital processing: Data representation, On/Off Control, Analog Control, Digital Control, Supervisory Control, Direct Digital control, Smart Sensor, Networked Control Systems, PLC for On/Off Control application, Analog Data Representation and problems.

MODULE-II	**8 Hours**

Final Control Elements: Elements of final control operation, Electric actuators, pneumatic actuators, hydraulic actuators, control elements, mechanical control element, electrical control element, fluid valves, principles, control valve types, control valve sizing,

Basic Instrumentation P&ID diagrams: Instrumentation symbols. Introduction to Process Flow Diagram (PFD) and Piping & Instrumentation Diagram (P&ID).

MODULE-III	**8 Hours**

Analog Signal Conditioning: Principles, Signal level and bias changes, Linearization, Filtering and impedance matching concept of loading. Op-Amps in Instrumentation, Design Guidelines.

Controller Principles: Process characteristics, control system parameters, discontinuous controller modes, continuous controller modes-proportional control mode, derivative control mode and integral control mode, composite controller modes – PI, PD and PID control mode.

MODULE-IV	**8 Hours**

Analog Controllers: General features, Electronic controllers, Error detector, Single mode, composite controller modes, Pneumatic controllers, Design considerations.

Digital Controllers: Digital electronic methods, Simple alarms Two position control, Multivariable alarms, Data loggers, Direct digital and Supervisory control.

MODULE-V	**8 Hours**

Control-Loop Characteristics

Control system quality, Process loop tuning, Open - loop transient response method, Ziegler - Nichols method.

Paradigm of Process Control: Cascade control systems, Selective control systems, Split- range control systems.

LAB EXPERIMENTS:

1. Simulation and experimentation of Analog signal conditioning circuits, linearization, and calibration concepts.
2. Design and implementation of discrete, continuous and composite controllers using discrete analog components.
3. Design and implementation of Digital controllers using discrete components.
4. Determination of characteristics of different types of valves and experiments on it.
5. Cascade process trainer – level control using P,PI,PD PID controller

6.Flow control using P,PI,PD PID controller

7. Temperature control using P,PI,PD PID controller

8. Tuning of controllers by different methods.

Case Study: Process Flow diagrams, Process Safety in various plants.

Text books:

1.	Process Control Instrumentation Technology by C.D .Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002.
2.	Chemical Process Control – George Stephanopoulos, 4th Indian reprint, PHI Ltd., 1997.

References:

1.	Process/ Industrial Instruments and Control Handbook, D.M. Considine, McGraw Hill International, 4th Edition, 1993.
2.	Computer Based Industrial Control by Krishna Kant, PHI, New Delhi 1997.
3.	Process dynamics and control by S.S.Bhagade and G.D.Nageshwar PHI publications New Delhi, 2011.
4.	Lessons in Industrial Instrumentation by Tony R. Kuphaldt, Creative Commons Attribution License (open source textbook), Sept. 2008

E-References

1.	https://www.amazon.in/Process-Control-Instrumentation-Technology-Johnson/dp/0131194577
2.	https://www.amazon.in/Chemical-Process-Control-Introduction-Practice/dp/8120306651
3.	http://www.learnerstv.com/Free-engineering-Video-lectures-ltv689-Page1.html http://nptel.ac.in/courses/103105064/

Internal choice: Module – II & 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: Understand the basic principles, develop schematics, and block diagrams for diverse industrial process control systems by comprehending the fundamental ideas.

CO2: Apply the knowledge of Process Instrumentation Diagrams for industrial process control environment.(PO-1,2)

CO3: Analyze & design electronic analog and digital P, I, D, PI, PD, PID controllers for a given process(PO-1,3,4)

CO4: Design, interpret and implement tuning of the controllers.(PO-1,2,4,7)
CO5 : Choose an appropriate final control element for a given process.(PO-1,2,4,5,9)
CO6: Engage in independent study and communicate effectively (PO-9,10)

Course Title	**Basic VLSI Design**				
Course Code	**23EI5PCVLI**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Digital electronics, analog electronics					
MODULE-I					**8 Hours**
Introduction to MOS Technology: Moore's law, speed power performance, Nmos fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS. **Basic Electrical Properties of MOS and BiCMOS Circuits :** Drain to source current versus voltage characteristics, threshold voltage, trans conductance, nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, MOS transistor circuit model, BiCMOS inverters,					
MODULE-II					**8 Hours**
MOS and BICMOS Circuit Design Processes: MOS layers, stick diagrams, nMOS design style,CMOS design style, design rules and layout, λ - based design, scaling of MOS circuits, scaling factors for device parameters, and limitations of scaling.					
MODULE-III					**8 Hours**
Subsystem Design and Layout -1 : Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers.					
MODULE-IV					**8 Hours**
Subsystem Design and Layout -2 : Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.					
MODULE-V					**8 Hours**
Memory, Register and aspects of Timing: Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.					
LAB EXPERIMENTS:					

PART A: DIGITAL DESIGN: Write the Verilog code for the following circuits and observe the Waveforms and synthesize the code with technological library with given constraints- An Inverter and Buffer, Transmission Gate, Basic/Universal Gates, Flip flops, Counters, Registers, Adders **PART B**: ANALOG DESIGN: Design an inverter circuit by drawing the schematic and verify The following: i) Transient Analysis ii) DC Analysis, Design the following circuits with given Specification, draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis, Common Source Amplifier, Common Drain Amplifier, Differential Amplifier	
Text books:	
1	Basic VLSI Design -3rd Edition Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 2005.
Reference books:	
1	CMOS Digital Integrated Circuits, Analysis And Design, 3rd Edition, Sung – Mo (Steve) Kang,YusufLeblbici, Tata McGraw Hill, 2002.
E-References:	
1	https://www.sanfoundry.com/best-reference-books-vlsi-system-design/
2	https://www.freebookcentre.net/Electronics/VLSI-Books-Download.html
e learning :	
1	http://nptel.ac.in/downloads/117101058/
2	http://vlsi.cs.ucf.edu/books/intro-nmos-cmos.pdf
Internal choice: MODULE – I & V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand the basic concept of fabrication process for MOS devices .	
CO2: Apply design rules to create stick diagrams and layouts for MOS devices.	
CO3: Design combinational and sequential logic structures.	
CO4: Analyze and optimize the characterstics performance of sub-system design.	
CO5: Realize the sub-system design using modern tools for validation	

Course Title	**DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS**				
Course Code	**23EI5PCDSA**	**Credits**	**4**	**L-T-P**	**3:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Pre-requisites: Fourier series, Fourier transform ,Signals and systems.	
MODULE-I	**(8 Hours+2 Hours)**
Introduction to DSP, Frequency-domain Sampling, DFT, IDFT, DFT as a Linear Transformation (Matrix formulation), Properties of DFT: Periodicity, Linearity, Circular Time shifting, Circular Frequency Shifting, Circular Time Reversal, Conjugation and Conjugate Symmetry (Symmetry properties), Duality, Circular Convolution (Multiplication of two DFTs), Circular correlation, Multiplication (or Modulation) property, Parseval's Relation.	
MODULE-II	**(8 Hours +2 Hours)**
Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap add and save methods. Relation between DFT and other transforms. Direct computation of DFT. Necessity for efficient computation of DFT. Radix 2 Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation in time algorithm, decimation in frequency algorithms. Radix 2 FFT algorithm for computation of Inverse Discrete Fourier Transform. (IDFT).	
MODULE-III	**(8Hours +2 Hours)**
Implementation of Discrete Time IIR Systems: Introduction to realization of digital systems, block diagrams representation, Realization of Infinite Impulse Response (IIR) systems: parallel form, cascade form. Introduction to IIR filters, Pole zero placement method for simple IIR Filters, Impulse invariant & Bilinear Transformations, Design of Analog Butterworth and Chebyshev filters, Design of Digital Butterworth and Chebyshev filters.	
MODULE-IV	**(8 Hours+2 Hours)**
Implementation of Discrete Time FIR Systems: Realization of Finite Impulse Response (FIR) systems: Direct Form, Linear Phase Form. Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, Frequency sampling technique of designing FIR filters, Windowing design of FIR filters using Rectangular, Triangular & Hamming windows.	
MODULE-V	**(8 Hours+ 2 Hours)**
Application of digital filters in noise cancellation; Limitations of Linear filters, Random noise cancellation, Adaptive filters, LMS Algorithm, Applications. Decimation by a factor D, Interpolation by a factor I, Sampling conversion by a Rational factor I/D. Introduction to Multi-rate Digital Signal Processing. Parametric and non-parametric spectral estimation. Introduction to multirate signal processing. Application of DSP to Speech and Radar signal processing.	
Tutorial Sessions: Tutorial sessions will include problem solving, simulation using MATLAB/SCILAB and case study-based experiments for implementing algorithms for discrete systems using DSP Processor.	

Text Books:	
1.	Digital Signal Processing, Principles, Algorithms and Applications, John G.Proakis, Dimitris K Manolakis, Pearson education/PHI, (4th Edition)
2.	Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.
Reference books:	
1.	Fundamentals of Digital Signal Processing, Lonnie Ludeman, John Wiley & Sons; Wiley International 1st Edition, 1988.
2.	Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, Prentice-Hall Signal Processing Series, 2nd Edition, 1999
3	Understanding Digital Signal Processing, Richard G. Lyons,Prentice Hall, March 25, 2nd Edition 2004
4	Digital Signal Processing: Fundamentals and Applications, Li Tan, Academic Press, 1st edition 2007
5	Schaum's Outline of Digital Signal Processing, Monson Hayes, McGraw- Hill, 1st edition, 1998
6	Digital Signal Processing Concepts using Python", B Kanmani; ISTE-WPLP Learning Material series with specialization in, 'Electronics and Communication', Indian Society for Technical Education,Khanna Book Publishing Co. (P) Ltd.,first Edition 2024
E-References:	
1.	https://www.pearson.com/us/higher-education/program/Proakis-Digital-Signal-Processing-4th-Edition/PGM258227.html
2.	https://global.oup.com/academic/product/digital-signal-processing-9780198081937?cc=nz&lang=en
3.	http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html
e–Learning :	
1.	https://archive.nptel.ac.in/courses/108/105/108105055
2.	https://nptel.ac.in/courses/117/102/117102060/
Internal choice: Module 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 concepts of transform techniques in realizing Discrete time signal and Digital filters	
CO2: Analyze various transform techniques for discrete time signals and various methods to design digital Filter.	

CO3: Design of Analog and Digital Filters for given specifications.
CO4: Simulation and verification of various transform techniques Filter Design and Multirate Signal Processing

Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	**23CV5HSEVS**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Course Objective: The students will be able to develop a sense of responsibility about the environment, natural resources, their conservation and Understand the concept, structure and function of different ecosystems and the ill effects of environmental pollution and other environmental issues like population growth, Acid rain, global warming etc.,

MODULE-I	**5 Hours**

Introduction to Environment:

- Definition, about the Earth, Earth's Structure i.e. Atmosphere and its parts, Hydrosphere, Lithosphere and Biosphere.
- Ecology & Ecosystem, Balanced ecosystem, types of Ecosystem.
- Human activities - Food, Shelter, Economic & Social Security.
- Effects of Human activities on Environment: Agriculture, Housing, Industries, Mining and Transportation activities.
- Environmental Impact Assessment (E I A)

MODULE-II	**4 Hours**

Natural Resources:

- Definition, Renewable and Non-Renewable sources.
- Major Natural Resources are -
  - Water resources, its availability, quality, water borne & water induced diseases,
  - Mineral resources, classification, uses in various Industries as byproducts.
  - Forest resources – causes & consequences of deforestation, various afforestation programs.
- Conventional and Non-conventional energy resources -
  - Hydroelectric, Wind power, Solar, Biogas, geothermal energy.
  - Fossil fuel based energy resources – Coal, Oil & Gas, Nuclear power

Hydrogen as an alternate future sources of energy.

MODULE-III	**3 Hours**

Environmental pollution:

Introduction, following are few types of pollutions to study -

- Water pollution - definition, types, sources, effects and control of water pollution.
- Land pollution - definition, types, sources, effects, Solid waste management.
- Noise pollution - definition, sources, effects & control of noise pollution.
- Air pollution - definition, sources, effects & control of air pollution

MODULE-IV	**3 Hours**

Current environmental issues & importance

- Population growth, effects & Control, Climatic changes,
- Global warming, Acid rain, Ozone layer depletion and its effects.
- Environmental protection – initiatives by Government and non–Govt. Organizations (NGO's), Role of Legal aspects.
- Environmental Education, Women education.

Text books:

1.	Environmental studies by - Dr. Geethabalakrishanan (Revised Edition-Sun star publication)
2.	Ecology by – Subramanyam (Tata McGraw Hill Publication)
3.	Environmental studies by – Dr. J.P.Sharma (Fourth edition)
4.	Environmental studies by – Smriti Srivastav (Published by Kataria & Sons)

Reference books:

1.	Environmental studies by – Benny Joseph
2.	Environmental studies by – Dr. D.L.Manunath

E-References

1.	NPTEL (Open Sources / power point and visuals)
2.	Ecological studies / IITR / Open Sources
3.	Ministry of Environment and forest & wildlife.

e–Learning :

1.	https://www.coursera.org / course / sustain

SEE PAPER PATTERN:

C I E Marks: Conduct 3 Tests, considering best of 2. The pattern of Test paper consists of two parts. Part-A consists of 20 MCQs for 1 mark each; Part-B consists of 3 descriptive questions, 10 marks each. Student should answer 2 full questions from part-B. Two quizzes, each quiz is for 5 marks covering full syllabus.

TOTAL CIE MARKS: 20+20+10=50 MARKS

SEE QUESTION PAPER PATTERN

PART-A

20 Multiple Choice Questions Covering full syllabus

1 Mark each, students have to attend all questions

PART-B

Consist of 4 main questions. It may be subdivisions of 3 or 4.

Each question consists of 10 marks, covering full syllabus

Student should Answer only 3 full questions. 30 marks

SEE TOTAL MARKS : 20+30=50 MARKS

Course outcomes

At the end of the course on **Environmental Studies**, the student will have the

CO1: Discuss the components and impacts of human activities on environment.

CO2: Apply the environmental concepts for conservation and protection of natural resources.

CO3: Identify and establish relationship between social, economic and ethical values from environmental perspectives.

Course Title	**DIGITAL SYSTEM DESIGN**				
Course Code	**23EI5PE1DS**	**Credits**		**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Concepts of Digital Electronics

MODULE-I	**8 Hours**

Introduction to Verilog:

Design Methodology-An Introduction Verilog History, System representation, Number representation and Verilog ports. Verilog Data Types: Net, Register and Constant.

Verilog Operators: Logical, Arithmetic, Bitwise, Reduction, Relational, Concatenation and Conditional. Verilog Primitives.

MODULE-II	**8 Hours**

Modeling Styles:

Dataflow Modeling: Boolean Equation-Based Models of Combinational Logic, Propagation Delay and Continuous Assignments.

Structural Modeling: Design of Combinational Logic, Verilog Structural Models, Module Ports, Top-Down Design and Nested Modules. Gate level modelling.

MODULE-III	**8 Hours**

Behavioral Modeling: Behavioral Models of Flip-Flops and Latches, Comparison of Styles for Behavioral modeling, Behavioral Models of Multiplexers, Encoders, and Decoders. Test benches.	
MODULE-IV	**8 Hours**
Synchronous sequential circuits: Moore and Mealy FSM, Design and implementation of sequence detector, serial adder, code converter.	
MODULE-V	**8 Hours**
Implementation Fabrics: Introduction of Programmable Logic Array (PLA), Programmable Array Logic (PAL), Programmability of PLDs. Complex PLDs (CPLDs), Field-Programmable Gate Arrays (FPGA).The Role of FPGAs in the ASIC Market, FPGA Technologies. Comparison of design implementation using CPDs, FPGA and ASIC.	
Text books:	
1.	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design & Synthesis",SunSoft Press, 2ndEdition, 2009, ISBN: 978-81-7758-918-4.
2.	Stephan Brown and Zvonk Vranesic, "Fundamentals of digital logic withVerilog design", 2nd edition MGH, 2008.
Reference books:	
1.	Roth, Charles; John, Lizy K.; Kil Lee, Byeong Digital Systems Design Using Verilog ISBN 10: 1285051076 / ISBN 13: 9781285051079.
2.	M.D. Ciletti Advanced Digital Design with the Verilog HDL Published byPrentice Hall PTR -2nd Edition ISBN: 0136019285.
E-References	
1.	ElectronicDesignAutomationhttp://nptel.ac.in/courses/106105083/
2.	DigitalsystemdesignwithPLDsandFPGAshttp://nptel.ac.in/courses/117108040/ Fundamentals of HDL (Lecture #008)
3.	https://www.youtube.com/watch?v=rdAPXzxeaxs&index=8&list=PLE3BC3EB C9CE 15FB0
e–Learning :	
1.	http://access.ee.ntu.edu.tw/course/dsd_99second/2011_lecture/W2_HDL_Fun damentals_2011-03-02.pdf
2.	http://ece.niu.edu.tw/~chu/download/fpga/verilog.pdf
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 HDL for modelling and functional verification of digital circuits.
CO2	Analyze digital circuits using suitable Verilog HDL modelling.
CO3	Design a digital circuit for complex systems using Verilog HDL and statemachines.

CO4	Program a given application/problem statement using EDA tools.

Course Title	**INDUSTRIAL PROCESS INSTRUMENTATION**				
Course Code	**23EI5PE1PI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Pre-requisites: Principle of different Measurement devices and their applications.

MODULE-I — **8 Hours**

Measurement of Viscosity, Humidity and Moisture: Saybolt viscometer - Rotameter type and Torque type viscometers. Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements – Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

MODULE-II — **8 Hours**

Temperature & Pressure Measurement: Definitions and standards –Different types of filled in system thermometers – Bimetallic thermometers – IC sensors – Thermocouples, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation,, Special techniques for measuring high temperature using thermocouple –- Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Fiber optic sensor for temperature measurement – Thermograph – Temperature sensor selection, Installation and Calibration, Manometers: Different types, Bourdon tube, Bellows, Diaphragms and Capsules, Pressure gauge selection, installation and calibration using dead weight tester.

MODULE-III — **8 Hours**

Flow Measurement: Orifice plate: different types of orifice plates – Cd variation – pressure tapping– Venturi tube – Flow nozzle – Dall tube – Pitot tube, Installation and applications of head flowmeters, Positive displacement flow meters, Rotameter –theory, characteristics, installation and applications, Mass flow meter, Calibration of flow meters: – Dynamic weighing method**.**

MODULE-IV — **8 Hours**

Electrical Type Flow Meters: Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement**.**

MODULE-V — **8 Hours**

Level Measurement And Transmitter: Level measurement: Float gauges - Displacer type, Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep

method - Solid level measurement, Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters.	
Text books:	
1.	Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design", 6thMcGraw-Hill Education Pvt. Ltd
2.	A.K. Sawhney and PuneetSawhney, "Mechanical Measurements and Instrumentation and Control", DhanpatRai & Co.(P) Limited
Reference books:	
1.	A.K. Sawhney and PuneetSawhney, "Mechanical Measurements and Instrumentation and Control", DhanpatRai & Co. (P) Limited.
2.	Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, McGraw-Hill Education.
E-References	
1.	https://www.notesforgeeks.in/2022/12/ei3451-syllabus-industrial-instrumentation-
2.	https://www.researchgate.net/topic/Industrial-Instrumentation/publications
3.	https://www.researchgate.net/topic/Industrial-Instrumentation/publications
e–Learning :	
1.	https://swayam.gov.in/
2.	https://www.edx.org/course/
Internal choice: MODULE – I & IV	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Understand Principles and working of Viscosity, Humidity, Moisture, temperature , pressure, flow and level measuring Instruments	
CO2: Calibrate temperature, flow, level and Pressure measuring devices.	
CO3: Apply measurement of Viscosity, Humidity, Moisture, temperature, pressure, flow and level in Industrial Applications.	
CO4: Select and install Industrial instruments for various applications	
CO5: Understand various Electrical type Industrial Instruments	

Course Title	SENSOR ANALYTICS AND EDGE DEVICES				
Course Code	23EI5PE1SE	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks(50% weightage)		

Pre-requisites: Linear Integrated circuits, Python programming

MODULE-I — **8 Hours**

Sensor Fundamental, Interfacing and Signal Conditioning:

Introduction, sensor classification, Thermal sensor, Humidity sensor, Capacitive sensor, Planar interdigital sensor, Planar electromagnetic sensor, Light sensing Technology, Moisture sensing Techonogy,CO_2 sensing technology, sensor parameters, selection of sensors .Change of Bias and Level of Signals, Loading Effect on Sensor's Output, A Few Guidelines to Design Signal Conditioning Circuit ,Factors Affecting Performance of Sensors, Effect of Temperature ,Degradation of Sensors

MODULE-II — **8 Hours**

Wireless Sensors Network and Power Supplies For Sensors:

Introduction ,Frequency of Wireless Communication , Development of Wireless Sensor Network Based Project, Wireless Sensor Based on Microcontroller and Communicating Device ,Wireless Sensor Network Based on Microcontroller and ZigBee Communicating Device ,Wireless Sensor Network Based on Only ZigBee , Power Sources ,Power from Mains Supply . Selection of Batteries, ,Energy Harvesting Solar Energy, Energy Management Techniques

MODULE-III — **8 Hours**

Sensors Signal Processing Techniques

Introduction- A Brief Review of Signal Processing Techniques for Structural Health Monitoring, Normalization Feature Extraction, Dimensionality Reduction ,Collaborative Damage Event Detection (CBED) Method ,Signal Processing Techniques for Information Extraction from Sensor Data.

Deriving Information from Sensor Data: Daily Activity Recognition Models, The Hidden Markov Model (HMM), Emerging Patterns (EP), Finding Patterns in Sensor Data, Classifying Sensor Data, Detecting Trends, Characterizing Sensor Data.

MODULE-IV — **8 Hours**

Introduction to Machine learning in wireless Sensor Networks: Algorithms, strategies and applications:

Introduction to machine learning in wireless sensor networks, Supervised Learning- K-nearest neighbour, Decision tree, Neural networks, Support vector machines ,Bayesian statistics,

Unsupervised Learning- K-means clustering, Principal component analysis, miscellaneous applications, Applications of machine learning in wireless sensor networks

MODULE-V	**8 Hours**

Edge computing:

Introduction, Edge computing characteristics, Overview of edge computing, Security and privacy in edge computing ,Intersection of machine learning and edge using enabling technologies, Machine learning and edge bringing AI to IoT, OpenVINO toolkit, Challenges in machine learning and edge computing integration

CASE STUDIES:

1.Measurement of Human Body Temperature

2.Intelligent Sensing System for Emotion Recognition

3.WSN Based Smart Power Monitoring System

Text books:

1.	"Intelligent Sensing, Instrumentation and Measurements", Subhas Chandra Mukhopadhyay, Springer
2.	"Wireless Sensor Networks" Hossam Mahmoud Ahmad Fahmy, Springer Singapore
3.	"Data Acquisition and Signal Processing for Smart Sensors'', Nikolay V. Kirianaki , Sergey Y. Yurish ,Nestor O. Shpak (Author), Vadim P. Deynega , John Wiley & Sons, Ltd
4	Artificial Intelligence and Machine Learning for EDGE Computing, Rajiv Pandey Amity University, Lucknow, India Sunil Kumar Khatri Amity University, Tashkent, Uzbekistan Neeraj Toulouse, France, Parul Verma Amity University, Lucknow, India, Academic Press an imprint of Elsevier Kumar Singh Department of Computing and Applied Mathematics, INPT-ENSEEIHT / IRIT

Reference books:

1.	"Smart Sensor Systems", Emerging Technologies and applications, Gerard Meijer, Kofi Makinwa, Michiel Pertijs,John Wiley & Sons
2.	"Handbook of Wireless Sensor Networks: Issues and Challenges in Current Scenario's", **Singh** P.K., **Bhargava** B.K., **Paprzycki** M., **Kaushal** N.C., **Hong** W C, Springer
3.	"Machine Learning in Wireless Sensor Networks: Algorithms, Strategies, and Applications", Mohammad Abu Alsheikh, Shaowei Lin, Dusit Niyato and Hwee-Pink Tan, IEEE Explore-IEEE Communications Surveys & Tutorials

E Books

1.	https://onlinecourses.swayam2.ac.in/arp20_ap41/preview
2.	https://nptel.ac.in/courses/108/108/108108147/
3.	https://onlinecourses.nptel.ac.in/noc23_cs65/preview#:~:text=Edge%20computing%20has%20recently%20developed,computing%20at%20the%20network%20edge

Internal choice: MODULE – III & IV
Course outcomes At the end of the course ,the student will have the ability
CO1: understand and explain the basic knowledge of sensors used for making wireless sensors or smart sensors.
CO2: To relate the issues of interfacing sensors to a processor and signal conditioning, also integration of edge to Machine learning, , Edge devices and its characteristics
CO3: Analyze interaction among different components and importance of developing of a WSN , a power supply and different energy harvesting techniques
CO4: Apply signal processing techniques for analyzing the sensors data
CO5: Implement Machine learning algorithms
CO6: To make a report on case studies and make presentation

Course Title	**C++ AND DATA STRUCTURES**				
Course Code	**23EI5PE1CD**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: C Programming					
MODULE-I					**8 Hours**
Principles of Object Oriented Programming - Basic Concepts of OOPS, OOP Languages, Pre-processors directives and header files, structure of C++ program, compiling and linking, Tokens, keywords, identifiers and constants, datatypes, symbolic constants, variables, Storage Classes, operators, manipulators, control and statement loops. **Functions in C++:** Introduction, Main function, function prototype, call by reference, return by reference, inline functions.					
MODULE-II					**8 Hours**
Classes and objects: Specifying a class, member functions, arrays within a class, static data members and member functions, arrays of objects, functions returning objects. **Constructors and Destructors:** Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors and destructors. **Operator overloading and type conversions**: Overloading unary and binary operators, overloading using friends, rules of overloading, function overloading, friend functions.					
MODULE-III					**8 Hours**
Inheritance - Introduction, defining derived classes, Types of inheritance: Single, multilevel,					

multiple, hierarchical, hybrid.

Pointers, Virtual and Polymorphism: Pointers, pointers to objects, this pointer, pointers to derived classes, virtual functions.

Templates: Class templates, Function templates.

MODULE-IV	**8 Hours**

File operations: Introduction, classes for file stream operations, Opening and closing a file using constructors, detecting end-of-file.

Data Structures: Introduction, Classification

Arrays: Types, Representation, Operations- Traversing, Insertion, Deletion, Sorting, Searching.

Linked List: Introduction, Representation of Linked List in Memory, Dynamic Representation, Singly Linked List, Operations, Doubly Linked Lists, Representation of Doubly Linked List.

MODULE-V	**8 Hours**

Stacks: Definition, Representation of a Stack, Linked Representation of a Stack, Operations on Stack, Applications of Stacks - Balancing of the Matching Parenthesis.

Queues: Representation of Queues, Linked representation, Operations on a Queue, Enqueue and De- queue Using Linked List.

Trees and Binary Trees: Terminologies, Representation of a Tree, Binary Trees, Array Representation of a Binary Trees, Linked Representation of Binary Trees, Binary Tree Traversals, and Applications of Binary Trees- Traversal of an Expression Tree.

Text books:

1.	"Object Oriented Programming with C++", E Balagurusamy, TMH Publications, Fourth Edition.
2.	"Data Structures and Algorithms Using C++", Ananda Rao Akepogu Radhika Raju Palagiri, Pearson Education, 2010

Reference books:

1.	"Programming: Principles and Practice Using C++", Bjarne Stroustrup, 2014
2.	"Borland C++ Builder: The Complete Reference", Herbert Schildt, Gregory L. Guntle, Osborne/McGraw-Hill Publications, 2001
3.	"Object oriented Programming with turbo C++", Robert Lafore, Galgotia Publications, 2007.
4.	"Data Structure and Algorithms Using C++ - A Practical Implementation", Sachi Nandan Mohanty, Pabitra Kumar Tripathy, Wiley-Scrivener 2021.

E-References

1.	https://www.mheducation.co.in/object-oriented-programming-with-c-9789389949186-india
2.	https://books.google.co.in/books?id=VRaxY61mw5cC&printsec=frontcover&dq=1.+%E2%

	80%9CData+Structures+and+Algorithms+Using+C%2B%2B%E2%80%9D,+Ananda+Rao+Akepogu+Radhika+Raju+Palagiri,+Pearson+Education,+2010&hl=en&newbks=1&newbks_redir=0&sa=X&ved=2ahUKEwjYie790N2BAxWRZt4KHcOfDmcQ6AF6BAgIEAI#v=onepage&q&f=false
e–Learning :	
1.	https://swayam.gov.in/nd1_noc20_cs07/preview
2.	https://www.programiz.com/cpp-programming
3.	https://nptel.ac.in/courses/106/106/106106133/
Internal choice: MODULE – III & V	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Understand the fundamental concepts of OOPS and Data Structures to develop programming skills.	
CO2: Identify and apply the concepts of C++ programming to solve problems**.**	
CO 3: Develop programs to demonstrate the benefits of operator overloading, inheritance, pointers and templates in the development of a program.	
CO 4: Apply C++ programming concepts to realize various data structures	
CO 5: Identify and apply a suitable data structure for a given application, articulate and communicate effectively	

Course Title	**MINI PROJECT**				
Course Code	**23EI5PWMPR**	**Credits**	**2**	**L-T-P**	**0:0:2**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

General Instructions:

1.A team of maximum three students shall be permitted to work on a single mini project.

2.The mini project shall comprise of hardware component. However, the software component is advisable but not mandatory.

3.Students shall be evaluated on regular and continuous basis as per the prevailing rubrics

4.The team shall ensure that the project is in working condition during final demonstration.

5.The student is required to submit a report based on the project work carried out.

6.The team needs to demonstrate their mini project developed at the end of semester (Poster

presentation will be recognized) 7.Projects having scope to be taken to next higher level in next semester will be encouraged.
CO1: Enhance the skills and competency of students by hands on experience for troubleshooting, maintenance and fabrication.
CO2: Inculcate innovative thinking and thereby preparing students for main project.
CO3: Promote presentation, record keeping and documentation of technical reports towards concept of entrepreneurship.
CO4: Disseminate the technical knowledge on recent technological trends and applications by demonstration of working prototype.
CO5: Demonstrate with ethics, effective communication skills and relate engineering issues to broader societal context.

Course Title	**PROJECT MANAGEMENT AND FINANCE**				
Course Code	**23ES5HSPMF**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Personality development course, soft skills					
MODULE-I					**5 Hours**
Concepts of Project Management: Concepts of project, Categories of project, Project lifecycle phases, Project management concepts, Tools and techniques for project management, The project manager, Need, Roles and responsibilities of project manager. Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects.					
MODULE-II					**5 Hours**
Establishing the Project - Scope, Time, Cost, and performance goals, Feasibility report, Financing Arrangements, Preparation of cost estimates, Finalization of project implementation schedule, Evaluation of the project profitability, Fixing the Zero date.					
MODULE-III					**5 Hours**
Organizing Human Resources and Contracting - Delegation, Project managers authority, Project organization , Contract , Contract Planning, Tendering and Selection of Contractor, Team building					
MODULE-IV					**5 Hours**
Organizing Systems and Procedures for Project Implementation – Working of Systems, Work break down structure, Planning, Scheduling and Monitoring, Critical Path Method, Gantt Chart/Time Chart, PERT, Project diary.					

MODULE-V	**5 Hours**
Financing of Projects - Capital structure, Menu of financing, Internal accruals, Equity capital, Preference capital, Debentures (or bonds), Methods of offering term loans, Working capital advances, Miscellaneous sources, Raising venture capital, Project financing structures, Financial closure, Financial institutions.	
Text books:	
1.	Project Management – S Choudhury, Tata McGRAW Hill Publishing Company Limited
2.	Projects- Planning , Analysis , Selection, Financing ,Implementation and Review –Dr. Prasanna Chandra McGRAW Hill Publishing Company Limited
3.	Project Management Institute A Guide to the Project Management Body of Knowledge PMBOK Guide (Sixth Edition), Sept 2017
Reference books:	
1.	Fundamentals of Project Management by Dr.Vijay Kanabar
2.	Project Management – David I Cleland – Mcgraw Hill International edition
3.	Project Management – Gopalakrishnan – Mcmillan India Ltd
4.	Project Management – harry – Maylor- Peason Publication
E-References	
1.	https://www.youtube.com/watch?v=5d16JwWwjKo
2.	https://www.youtube.com/watch?v=5pwc2DYlKQU
Internal choice: MODULE III and IV	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Apply the Knowledge of project management principles and to study the current market trends	
CO2: Choose projects and to implement project management methodologies ethically for successful project completion	
CO3: To identify the investment opportunities and to formulate the projects.	
CO4: Ability to choose projects which benefit the society and organization and apply	

VI SEMESTER

Course Title	PROCESS AUTOMATION				
Course Code	23EI6PCPSA	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Pre-requisites: Process Control, Basic Programming

MODULE-I — **8 Hours**

Introduction to Automation: Evolution, Components of automation in process control, Types of processes, Data loggers – Data Acquisition Systems (DAS), Introduction to Direct Digital Control (DDC), Distributed Control Systems (DCS).

Programming Logic Controller (PLC): Basic architecture, Types and its operation, I/O Modules: Discrete, Analog, Special types, I/O Specifications, CPU, Program scan, Programming standards of PLC.

MODULE-II — **8 Hours**

PLC Programming

Instructions: Branch, Modes of Operation, Developing fundamental PLC wiring diagrams and ladder logic programs. Manually operated switches, Mechanically operated switches, Sensors, Output Control Devices, Seal-in Circuits, Latching Relays, Related programming and practice examples, Programming timers - Applications.

MODULE-III — **8 Hours**

Programming using counters: Up counter, Down Counter, Cascading counters, Incremental encoder, Applications**.**

Data Manipulation Instructions: Data Manipulation, Data Compare/transfer, Numerical data I/O Interfaces.

Math Instructions: Arithmetic functions - comparison functions, logic functions, Data handling instructions, Sequencer and Shift Register Instructions. Applications

MODULE-IV — **8 Hours**

Distributed Control Systems: Functional components of DCS, Architecture of a simple DCS, Hierarchy of Plant Operations, i/o subsystems, Remote IO Bus, Bus connected IOs, Diagnostics in IOs, Controllers, Workstations, Functional Features of DCS.

MODULE-V — **8 Hours**

SCADA

Introduction**,** Basic Components, Architecture, Types of SCADA System, Applications, Advantages.

HMI in Automation:

Introduction to HMI, Architecture Of HMI, Human Interface subsystem, Construction of the panel **Control Subsystem: Interfacing** with control subsystem, Types of mimic panels, Advance Human Interface System, Intelligent Operator Panel, Operator Station.	
Text books:	
1.	"Programmable Logic Controllers", Frank D. Petruzella, McGraw-Hill Higher Education; 6th edition, 2022.
2.	"Industrial Process Automation Systems- Design and Implementation", B.R. Mehta Y. Jaganmohan Reddy, 1st Edition, Elsevier, 2014
Reference books:	
1.	"Industrial Automation from Scratch: A hands-on guide to using sensors, actuators, PLCs, HMIs, and SCADA to automate industrial processes", Olushola Akande, Packt Publishing Limited, 2023
2.	"Advanced Industrial Automation: PLC programming in simplest way with 110 solved examples", Himanshu Kumar, Notion Press, 2020.
3.	"Guide to Supervisory Control and Data Acquisition (SCADA) and Industrial Control Systems Security- Recommendations of the National Institute of Standards and Technology", Stouffer, Keith & Falco, Joseph & Kent, Karen, 2006.
4.	"Mitsubishi FX Programmable Logic Controllers_ Applications and Programming" John Ridley - 2004, Newnes
E-References	
1.	https://www.abebooks.com/servlet/SearchResults?an=frank%20petruzella&bsi=30&sortby=17&tn=programmable%20logic%20controllers
2.	https://www.elsevier.com/books/industrial-process-automation-systems/mehta/978-0-12-800939-0
e–Learning :	
1.	https://nptel.ac.in/courses/108/105/108105062/#
2.	https://www.udemy.com/course/plc-programming-from-scratch/
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 control systems, DCS, SCADA for process automation.	
CO2: Investigate the requirement of PLC, DCS, SCADA in various scenarios.	
CO3: Analyze and develop appropriate algorithms to design automation solutions.	

CO4: Implement the solutions to automate a process control system using modern tools.
CO5: Engage in independent study and communicate effectively through presentations and reports.

Course Title	**INDUSTRIAL DATA NETWORKS AND SAFETY**				
Course Code	**23EI6PCIDS**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Analog and Digital Communication.					
MODULE -I					**8 Hours**
DATA NETWORK FUNDAMENTALS Data communication, Network and types, OSI Model, Data link control protocol: HDLC, Media access protocol, Command/response, Token passing, CSMA/CD, TCP/IP Protocol.					
MODULE -II					**8 Hours**
INTER NETWORKING: Bridges, Routers, Gateways, Industrial Ethernet: 10Mbps Ethernet, 100Mbps Ethernet, Data-Link Layer Protocols, Media Access Control, Wired LANs, RS 232 and RS 485.					
MODULE -III					**8 Hours**
HART AND FIELDBUS: Introduction, Evolution of signal standard, HART communication protocol, Communication modes, HART networks, HART commands, HART applications. Fieldbus: Introduction, General Fieldbus architecture, Basic requirements of Field bus standard, Fieldbus topology, Interoperability, Interchangeability, Introduction to OLE for process control (OPC). CAN Bus.					
MODULE -IV					**8 Hours**
MODBUS AND PROFIBUS MODBUS protocol structure, function codes, troubleshooting Profibus: Introduction, profibus protocol stack, profibus communication model communication objects, system, operation, troubleshooting.					
MODULE -V					**8 Hours**
FUNCTIONAL SAFETY : Introduction, Safety Functions and Safety-Related Systems, Functional safety standards- IEC 1508 /IEC 61511, functional Safety Protocol, Profibus safety, Ethernet Power link Safety, Functional Safety of Electrical/Electronic/Programmable Safety-Related Systems. The role of standards organizations, Industry 4.0.					

Lab Experiments:

Using CISCO Packet Tracer

1) Create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping message.
2) Configure default route, static route to the Router
3) Configure IP address to routers in packet tracer. Explore the following messages: ping responses, destination unreachable, request timed out, reply
4) Configure IPv4 and IPv6 and learn Quality, security and other services
5) To construct simple LAN and understand the concept and operation of Address Resolution Protocol (ARP)
6) Configuring and Verifying IP Routing: Establish a communication between the hosts by connecting the network Devices. Configure 1. Static Routing 2. Dynamic Routing
7) Serial Communication Using
   a) RS232/RS485
   b) Modbus Communication,
8) Install and Configure HART point-to-point communication Network
9) Connect HART handheld communicator to HART network
10) Verification of frame structure of the Hart protocol, fieldbus and Modbus.

Text books:

1.	Data Communications and Networking, Behrouz A. Forouzan, ISBN: 0073376221, 2013
2.	Industrial Communication Systems, Bogdan M. Wilamowski, J. David Irwin, October 2017

Reference books:

1.	An Introduction to Computer Networks, Peter L Dordal, 2020
2.	Introduction to Data communication and Networking, Tomas, January 2007
3.	"Industrial Process Automation Systems- Design and Implementation", B.R. Mehta Y. Jaganmohan Reddy, 1st Edition, Elsevier, 2014

E-References

1.	https://elcom-hu.com/Subjects/Computer/Compulsory/Communication/Data-Communications-and-Network-5e.pdf
2.	https://books.google.co.in/books?id=gJbLBQAAQBAJ&pg=PR7&source=gbs_selected_pages&cad=1#v=onepage&q&f=false

3.	https://www.linkedin.com/pulse/safety-over-industrial-communiction-networks-dr-martin-kidman-phd
e–Learning :	
1.	https://archive.nptel.ac.in/courses/106/105/106105183/
2.	https://www.coursera.org/learn/illinois-tech-computer-networking
3.	https://pdhonline.com/courses/e497/e497content.pdf
Internal choice: MODULE – I & III	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Apply the concepts of network and communication protocol to models in Industrial Data Networking.	
CO2: Analyze inter-networking principles using standards and protocols.	
CO3 Implement HART, MODBUS and Profibus protocol in field devices.	
CO4: Engage in independent study to select protocol for industrial applications.	

Course Title	**EMBEDDED SYSTEM DESIGN**				
Course Code	**23EI6PCESD**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: ARM Processor, 'C' Programming.					
MODULE-I					**8 Hours**
Fundamentals of Embedded System: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware, Characteristics and quality attributes (Design Metric) of embedded system., Concept of RTOS, Drivers, Application programs, Power-supply (Battery technology, Solar), Safety and reliability, environmental issues. Ethical practice. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle					
MODULE-II					**8 Hours**
Embedded Software, Firmware Concepts and Design: Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming					
MODULE-III					**8 Hours**
Embedded Hardware and Design: Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R					

(CortexR4) and comparison in between them, ARM CortexM3 Instruction sets and programming: STM Microcontroller Assembly basics, Instruction lists and description, Useful instruction, Memory Mapping, Bit- Band operations, Assembly and C language programming.

MODULE-IV	**8 Hours**

Embedded Serial Communication: Study of basic communication protocols like SPI, SCI RS232, RS485, I2C Programming, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee

MODULE-V	**8 Hours**

Basic embedded C Applications: for using ARM-GCC- tool-chain, Emulation of ARM-v7, emulation board, Architecture of Raspberry Pi , Realtime Operating System

LAB Experiments :1) GPIO can be configured in alternate function mode to have USART operation and display a string of "Welcome to BMSCE, department of EIE". The program may be written using peripheral library functions.

2) GPIO configuration in alternate function mode to have ADC operation and display the ADC output.

3) ADC operation and display the ADC output on a serial display using USART.

4) Configure a GPIO pin as an input, to illustrate operation of a switch, using peripheral library functions and show the switch operation ON/OFF by configuring GPIO output pin connected to an LED.

5) Configure GPIO pins PC8 and PC9 as outputs in BSRR mode, connected to two LEDs on the discovery board, using register level programming. There is a 1000ms delay in between ON and OFF of LEDs. This delay may be generated using register level programming of Timer.

6) Configure the Timer 3 in PWM mode to have different Duty Cycles. Show the operation of PWM using intensity change of LED connected to a Port pin, by configuring GPIO pin in output mode.

7) Controlling Oven temperature using IoT based setup , with Telemon, IOTA module and RTD as a temperature sensor

8) IoT based Battery monitoring system with tele-monitoring option with Bluetooth connectivity

9) An IoT based Temperature monitoring with industrial temperature sensor setup and MODBUS protocol

10) Timer programming in ST Microcontroller for Distance measurement using IR sensors interfaced.

11) Study of MODBUS and RS232 C and RS 485 protocols for communication using ethernet. peripheral library functions.

12) Controlling the speed of a Gate using digital encoder and Master-Slave operation of ST

Microcontroller(STM32F4XXX)	
Text books:	
1.	Introduction to Embedded Systems: Shibu K. V. (TMH).
2.	The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, Joseph Yiu 3 Edition, EPUb
3	Discovering the STM32 Microcontroller, Geoffrey Brown 2012, This work is covered by the Creative Commons Attibution-Non CommercialShareAlike 3.0 Unported (CC BY-NC-SA 3.0) license.
Reference books:	
1.	https://www.st.com/resource/en/reference_manual/rm0008-stm32f101xx-stm32f102xx-stm32f103xx-stm32f105xx-and-stm32f107xx-advanced-armbased-32bit-mcus-stmicroelectronics.pdf
2.	Automatic Control Systems -B.C Kuo, John Wiley and Sons
E-References	
1.	https://books.google.co.in/books/about/INTRO_TO_EMBEDDED_SYSTEMS_1E.html?id=mp_neOX_uEEC
2.	http://esd.cs.ucr.edu/
e–Learning :	
1.	https://nptel.ac.in/courses/106/105/106105159/
2.	https://archive.nptel.ac.in/courses/106/105/106105193/
Internal choice : Modules – I & II	
Course Outcomes: The course outcomes will be attained through theory and laboratory assessments. At the end of the course, the student will be able to	
CO1: Apply the knowledge of microcontroller to understand the definition of Embedded Systems and Real time operations.	
CO2: Analyse the hardware requirements of 32-bit microcontroller with necessary Input/Output and memory operations to build simple Embedded system.	
CO3: Design a simple Embedded system using higher level programming to have PORT operation in general as well as alternate function modes accommodating inbuilt peripherals.	
CO4: Conduct experiments to differentiate wired and wireless serial communication protocols based on USART operation in ST Microcontrollers.	
CO5: Build Embedded Applications using input and output devices with ARM core and ST controller.	

CO6: Engage in independent study to learn applications based on Microprocessor architecture such as Rasberry PI.

Course Title	**RESEARCH METHODOLOGY AND IPR**				
Course Code	**23ES6AERMI**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
MODULE-I					**5 Hours**
Meaning and sources of research problem, Objectives and Characteristics of research – Errors in selecting research problem, Research methods Vs Methodology - Types of research- Criteria of good research – Developing a research plan.					
MODULE-II					**5 Hours**
Investigations of a research problem - Selecting the problem - Necessity of defining the problem – Data collections-analysis- Importance of literature review in defining a problem - Survey of literature -Necessary instrumentations					
MODULE-III					**5 Hours**
How to write paper-conference articles-poster preparation, thesis report writing, inclusion of references, journal reviewing process, journal selection process, filling about journal template, developing effective research proposal-plagiarism-research ethics					
MODULE-IV					**5 Hours**
Origin and meaning of the term patent, Objective of a patent law, principles underlying the patent law in India, the legislative provisions regulating patents, Non–patentable inventions. Procedure for obtaining patent, Provisional and complete specification, Rights conferred on a patentee, Transfer of patent, Infringement of patents, Action for Infringement,. Geographical indications.					
MODULE-V					**5 Hours**
Copy Right: Introduction, Ownership of copy right, Rights conferred by copy right, Terms of copy right, License of copy right, Infringement of copy right, Remedies against infringement of copy right. **Trade Marks:** Introduction, Statutory authorities, Procedure of registration of trademarks, Rights conferred by registration of trademarks, Licensing in trade mark, Infringement of trade mark and action against infringement.					
Text books:					

1.	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2.	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 420p.
3.	Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
Reference books:	
1.	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications
2.	Subbarau NR-Handbook of Intellectual property law and practice- S Viswanathan Printers and Publishing Private Limited 1998.
3.	Basic Principles and Acquisition of Intellectual Property Rights", Dr. T. Ramakrishna, CIPRA, NSLIU-2005.
4.	"Intellectual Property Law Handbook", Dr. B. L. Wadehhra, Universal Law Publishing Co. Ltd., 2002.

Course Title	**BIOMEDICAL INSTRUMENTAION**				
Course Code	**23EI6PE2BI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Sensors and Measurement					
MODULE-I					**8 Hours**
Components of Medical Instrumentation System: Terminology of medicine and medical devices, Generalized medical, Instrumentation systems, Classification of Biomedical instruments, Medical measurement constraints, The origin of Bio potentials, Electrical activity of excitable cells. Electrodes: The electrode-Electrolyte interface, Polarization, Electrode behavior and circuit models, Electrode arrays, Surface and Microelectrodes.					
MODULE-II					**8 Hours**
Signal Acquisition and Processing: Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters Electrodes for bio-physiological sensing and conditioning, Electrode electrolyte interface, polarization, The electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes					

Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC‘s DAC‘s) Processing, EEG using 10-20 electrodes.

MODULE-III	**8 Hours**

Cardio Measurements and Therapeutic Devices:

Electrical Conduction system of the heart. Cardiac cycle. Relation between electrical and mechanical activities of the heart. Cardiac Instrumentation: Blood pressure and Blood flow measurement. Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart. Blood flow meter, cardiac output, heart sounds and its measurement. Pacemaker, defibrillators.

MODULE-IV	**8 Hours**

Bio Telemetry: Biomedical Telemetry & Telemedicine:

Wireless telemetry, single channel telemetry, multi-patient telemetry, Multi-channel wireless telemetry Implantable telemetry systems Biotelemetry application on wix networks.

Essential parameter for telemedicine, Delivery models in telemedicine, Telemedicine system, Clinical data standards, Transmission of still images, Transmission of video images, Transmission of digital audio, Cyber medicine and application of telemedicine.

MODULE-V	**8 Hours**

Overview of Hospital Administration: Challenges in Hospital Administration, Hospital Planning- Equipment Planning, Functional Planning, Current Issues in Hospital Management, Telemedicine, Bio-Medical Waste Management

Medical expert system, Standards and practices for medical instruments / devices / equipment, Medical software, m-health, Introduction to c-Health – Medical Informatics, Certification Process

Text books:

4.	Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, Prentice Hall of India, New Delhi, 2007.
5.	Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw-Hill, New Delhi, 2003.
6.	R.C.Goyal, Hospital Administration and Human Resource Management‖, PHI –4th Edition, 2006

Reference books:

5.	John G. Webster, ―Medical Instrumentation Application and Design‖, John Wiley and sons, New York, 2009

6.	Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, UK,2003
7.	Claudio Becchetti, Alessandro Neri, ―Medical Instrument Design and Development from Requirement to Market Placements‖, Wiley Publication, 2013
E-References	
1.	https://books.google.co.in/books/about/Handbook_of_Biomedical _Instrumentation.html? id=bYsiBAAAQBAJ&redir_esc=y
2.	https://ioesolutions.esign.com.np/contents/elective-ii-biomedical-instrumentation
e–Learning :	
1.	https://swayam.gov.in/
2.	https://onlinecourses.nptel.ac.in/noc18_ec02
3.	https://www.edx.org/course/
Internal choice: MODULE – II & IV	
Course outcomes: At the end of the course ,the student will have the ability to	
CO1: Understand the concepts related to Biomedical Instrumentation.	
CO2: Apply the knowledge of engineering fundamentals to obtain biomedical signal acquisition and processing.	
CO3: Analyse the ECG signal and Interpret ECG waveform	
CO4: Investigate on Biomedical Telemetry & Telemedicine devices	
CO5: Engage student individually/ in a team to conduct hospital visit/case study on waste segregation and waste treatment for the disposal of Biomedical waste in hospitals and document the same.	

Course Title	**INDUSTRIAL INTERNET OF THINGS**				
Course Code	**23EI6PE2II**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: General Concepts of Sensors, Computer and Internet.					
MODULE-I					**8 Hours**
Internet of Things: Introduction, Evolution, Requirements/characteristics, challenges, SWOT analysis, Horizontal and vertical aspects of IoT, structure of IOT. Present communication models Networking and communication layer: IOT protocol stack, Wired/wireless communication, Internet layer, Application layer, comparison of IoT protocols					

MODULE-II	**8 Hours**
IIoT in Process Automation: IT + OT, ISA95 levels, Building blocks. Big Data: Data types, Process, ultimatums, characteristics, Comparison between small and big data. Big data analytics-types, applications, implementation challenges. Cloud Computing- advantages, service models, various cloud platforms and its comparison. Edge/Fog computing-Architecture, Comparison between cloud and fog	
MODULE-III	**8 Hours**
IIoT Reference Architecture: M2M and IIoT architecture, Industrial Internet Consortium, Industrial Internet Architecture Framework, Industrial Internet Viewpoints, Business, Usage, Functional-control domain, communication, modelling, asset management, Operational domain, Implementation. Architectural topology- Three tier, Connectivity, Key system characteristics	
MODULE-IV	**8 Hours**
Designing of Industrial Internet System: Concept of IIoT, proximity network, Middleware software patterns: Publish/subscribe pattern. IIOT Middleware architecture. Industry 4.0: Definitions, Four characteristics, Benefits, Design principles, Building blocks of Industry 4.0	
MODULE-V	**8 Hours**
Case Study: IIoT for Smart City Building blocks of smart city – candidate applications for SMART CITY. Study of proposed IIoT based solutions for this application, used cases and workshop **Case Study** : IIoT for Plant Operations Introduction to plant operations (A day in the refinery / video based sessions) Today / Current Practice vs IIOT impact, IIOT in process industry	
Text books:	
1.	"The Era of IOT- Towards a Smart World", Khaled Salah Mohamed -2019
2.	"Internet of Things and Big Data Analytics for Smart Generation-Springer Internet", Valentina E. Balas, Vijender Kumar Solanki, Raghvendra Kumar, Manju Khari
Reference books:	
1.	"The Internet of Things_Industrie 4.0 Unleashed ",Ulrich Sendler - 2018, Springer.
2.	"The Internet of Things 2012: New Horizons",A Smith, I.G. 2012.
3.	"Internet of Things: Architectures, Protocols and Standards", Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, Wiley, 2018
4.	"Internet of Things (IOT): Architecture and Design Principles", Raj Kamal. McGraw Hill,

	2017
E-References	
1.	https://www.ebay.com/p/15038550739
2.	https://www.springer.com/gp/book/9783030042028#:~:text=Internet%20of%20Things%20and%20Big,Generation%20%7C%20Valentina%20Emilia%20Balas%20%7C%20Springer
e–Learning :	
1.	https://www.udemy.com/course/internet-of-things-the-mega-course/
2.	https://www.udemy.com/course/introduction-to-industrial-iot-for-it-professionals/
Internal choice: MODULE – II and V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand the concept of Internet of Things and Industrial IoT	
CO2: Identify the risks and challenges associated with IoT, IIoT implementation and develop mitigation strategies.	
CO3: Apply knowledge of communication protocols to select the most suitable protocol for a specific IoT application.	
CO4: Evaluate the effectiveness of IIoT solutions in achieving desired outcomes.	
CO5: Propose IIoT solutions for industrial applications	

Course Title	**DIGITAL IMAGE PROCESSING**				
Course Code	**23EI6PE2DP**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Signals and Systems, Digital Signal Processing					
MODULE-I					**8 Hours**
Fundamentals: Introduction, Fundamental steps in Digital Image Processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, color images and color models. Implementation of algorithms.					
MODULE-II					**8 Hours**
Image Enhancement In Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial					

filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient. Implementation of algorithms.	
MODULE-III	**8 Hours**
Image Enhancement In Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal low-pass filters, Butterworth low-pass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homo morphic filtering. Implementation of algorithms. **Image Transforms:** Walsh , Haar, Hadamard , Slant , DCT	
MODULE-IV	**8 Hours**
Image Restoration: Image degradation and restoration models, noise models, restoration using spatial filtering – mean filter, geometric mean filter, harmonic mean filter, median filter, max & min filters, midpoint filter. Inverse filter, Wiener filter. Implementation of algorithms.	
MODULE-V	**8 Hours**
Image Segmentation: Introduction, thresholding: threshold detection methods, optimal thresholding, multi-spectral thresholding, edge based segmentation: edge image thresholding, border tracing, Hough transform, region-based segmentation: region merging, region splitting, splitting & merging. Matching: matching criteria.	
Text books:	
1.	Digital Image Processing - Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.
2.	Digital Image Processing, analysis and computer Vision- First edition, Milan Sonka, Cenage Learning, 2008.
Reference books:	
1.	Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
2.	Digital image processing, First edition, S.Jayaraman, S.Esakkirajan, J.Veerakumar, TMH-2008.
3.	Digital Image Processing**,** Abhishak Yadav, Poonam Yadav, Laxmi Publications
4.	Digital image Processing: An Algorithmic Approach, Madhuri A Joshi, PHI Learning Private limited
E-References	
1.	https://books.google.co.in/books/about/Digital_Image_Processing.html?id=a62xQ2r_f8wC&redir_esc=y

2.	https://www.cengage.com/c/image-processing-analysis-and-machine-vision-4e-sonka/9781133593607/?filterBy=Higher-Education
e–Learning :	
1.	http://nptel.ac.in/courses/117105079/
2.	https://www.cs.nmt.edu/~ip/lectures.html

Internal choice: MODULE - II & V.

Course outcomes

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

CO1: Define, explain and understand pixels, enhancement, restoration, segmentation, thresholding, identify steps ,components of Image processing system, relation between pixels

CO2: Discuss algorithms used for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding.

CO3: Discuss performance of algorithms for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding

CO4: Design and implement masks, algorithms for the given image processing application

CO5: Simulate the algorithms used in image processing using modern tools

Course Title	**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**				
Course Code	**23EI6PE2AM**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% Weightage)**		

Pre-requisites: Mathematics and Python programming

MODULE-I	**8 Hours**

Introduction: What is AI?

Intelligent Agents: How agent should act, Structure of Intelligent Agents, Environments

Problem Solving: Formulating problems, Example problems

Uniformed-search strategies: Breadth-First Search, Uniform Cost Search, Depth-FirstSearch, Depth Limited Search, Iterative Deepening Search

MODULE-II	**8 Hours**

Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis

MODULE-III	**8 Hours**

Learning: Well-posed learning problems, Designing a learning system, Perspectives and Issues in Machine Learning

Concept Learning: Find-S: Finding a maximally specific hypothesis, Version spaces and the candidate-elimination algorithm, Remarks.	
MODULE-IV	**8 Hours**
Decision Trees: Decision Tree Representation, Appropriate problems for decision tree learning, The Basic decision tree learning algorithm, Hypothesis space search, Inductive bias and Issues in Decision Tree learning.	
MODULE-V	**8 Hours**
Artificial Neural Networks: Neural Network Representation, Appropriate problems for neural network learning, Perceptron's, Multilayer networks and Back propagation algorithm. **Machine Learning Project:** Steps for End-to-End Machine Learning Project, Examples of Classification and Regression	
Text Books:	
1.	Machine Learning by Tom M Mitchell, McGraw-Hill Education, Indian Edition, 2016.
2.	Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.
3.	Hands-On Machine Learning with Scikit-Learn & Tensor Flow, Aurelian Geron, 2nd Edition, O'Reilly Media, 2019.
4.	Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015
e-Books:	
1.	http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf
2.	http://alex.smola.org/drafts/thebook.pdf
3.	https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/
e-references:	
1.	https://www.coursera.org/learn/machine-learning
2.	https://www.udacity.com/course/intro-to-machine-learning--ud120
3.	https://swayam.gov.in/nd1_noc19_cs52/preview
Internal choice: MODULE – I & II	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Represent procedural and declarative knowledge by applying agent-based rules (PO1)	
CO2: Apply the suitable search strategies and solve uninformed and informed problems (PO2)	
CO3: Provide logic-based analysis for question and answering techniques (PO2)	

CO4: Formulate probabilities for handling uncertain knowledge (PO3)
CO5: Design an Expert system (PO4)

Course Title	**CARBON INITIATIVE FOR CLIMATE**				
Course Code	**23EI6OE1CI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Environmental studies					
MODULE-I					**8 Hours**
Climate Overview, variability and Change in Climate Weather and Climate, Solar Radiation and Climate, Greenhouse Effect, Introduction to variability, Radiative Forcing, Detection and Attribution of Climate Change, Signs of climate change and metrics					
MODULE-II					**8 Hours**
Global Carbon Cycling and Carbon Inventory Introduction, Photosynthesis and Respiration, Timescales and Modes of the Carbon Cycle, Introduction to Carbon Budget, Global Warming, Atmospheric Carbon Inventory, carbon inventories in Biosphere and Soils, Oceans, Lithosphere					
MODULE-III					**8 Hours**
The Modern Carbon Cycle its mitigation and sequestration Introduction, Natural Global Carbon Cycle Before the Anthropogenic, Anthropogenic Perturbations to the Global Carbon Cycle, Global Carbon Budget, Drivers of Carbon Dioxide Emission, Options for Mitigating Greenhouse Gases Emission, Geoengineering Options for Climate Mitigation . Terrestrial Carbon Pools.					
MODULE-IV					**8 Hours**
Greenhouse Gas Mitigation under Agriculture and Livestock Land use, Global Forests Management Carbon Sequestration, Nature of Soil Organic Carbon Inputs and the Mechanisms for Its Stabilization in Soils, Greenhouse Gases Emission Trends from Agriculture, the Role of Forests in the Global Carbon Cycle, Estimation of Global Forest Area Trends and Its Carbon Pools, Global Forest Biomass Accumulation and Productivity Trends, Climate Change Mitigation Options Under Forest					
MODULE-V					**8 Hours**
The Role of Bioenergy in Mitigating Climate Change					

Introduction, Definitions, General Background on Biofuels, Role of Biomass Crops, History of Biofuels, Bioenergy Resources Potential Classification of Biofuels, Perspectives and Future Directions of Bioenergy , Carbon Capture and Storage , Storage of Carbon Dioxide in Deep Geological Formations, Risks of Geological Storage of CO2 , Monitoring and Risk Management	
Textbooks:	
1.	Carbon Sequestration for Climate Change Mitigation and Adaptation, David A.N. Ussiri, Rattan Lal, Springer, ISBN 978-3-319-53843-3, ISBN 978-3-319-53845-7
2.	Carbon Sequestration and Its Role in the Global Carbon Cycle, Brian J. McPherson, Eric T. Sundquist, wiley, ISBN:9781118671795, 1118671791
Reference books:	
1.	Energy and Climate Change-An Introduction to Geological Controls, Interventions and Mitigation, Elsevier Science
2.	Climate Intervention-Carbon Dioxide Removal and Reliable Sequestration, National Research Council, National Academies Press,
E-References	
1.	https://eplibrary.libguides.com/CART/SR/Climate_change/e-books
2.	https://www.everand.com/book/507472370/The-Impacts-of-Climate-Change-A-Comprehensive-Study-of-Physical-Biophysical-Social-and-Political-Issues
e–Learning:	
1.	https://www.my-mooc.com/en/mooc/global-warming-i-the-science-and-modeling-of-climate-change/
2.	https://www.my-mooc.com/en/mooc/global-warming-ii-create-your-own-models-in-python/
3.	https://www.my-mooc.com/en/mooc/ecosystem-based-adaptation-working-with-nature-to-adapt-to-a-changing-climate/
Internal choice: MODULE IV &V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: understand climate change, carbon cycle, mitigation, Sequestration	
CO2: analyse the problems of carbon cycle, its inventory, mitigation	
CO3: develop an overview of appropriate considerations for Greenhouse Gas Mitigation, Global Forests Management, Carbon Capture, Storage, risk management	

Course Title	FUNDAMENTALS OF HDL				
Course Code	23EI6OE1HD	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Pre-requisites: Digital Electronics / Logic Design

MODULE-I	**8 Hours**

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Program structure, Top-down and Bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block, Verilog Data types and Operators, system tasks, compiler directives

MODULE-II	**8 Hours**

Gate-Level Modelling: Modelling using basic Verilog gate Primitives, Description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays, Design of Decoders, Multiplexers in Gate-level Modelling

MODULE-III	**8 Hours**

Dataflow Modelling: Continuous assignments, Delay specification, expressions, operators, Design in dataflow model.

Structural Modeling Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Gate-level Modelling

MODULE-IV	**8 Hours**

Behavioral Modelling: Procedural Assignments, Initial and always blocks, blocking and non-blocking statements, delay control, conditional statements, Multiway branching, loops, sequential and parallel blocks, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Behavioral model

MODULE-V	**8 Hours**

Components Test and Verification: Test Bench - Combinational Circuits Testing, Sequential Circuits Testing, Test Bench Techniques, Design Verification, Assertion Verification

Text books:

1.	Samir Palnitkar-Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd Ed., 2009
2.	Michel D. Ciletti- Advanced Digital Design with Verilog HDL,2nd Ed., PHI, 2009

Reference books:

1.	Padmanabhan, Tripura Sundari -Design through Verilog HDL, Wiley, 2016
2.	S.Brown, Zvonko – Vranesic, Fundamentals of Digital Logic with Verilog Design, TMH, 3 rd Ed., 2014.

E-References

1.	http://www.ece.ubc.ca/~saifz/eece256.html
2.	http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/digital_circuit /frame/index.html
e–Learning :	
1.	http://www.ece.ubc.ca/~saifz/eece256.html
2.	http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/digital_circuit /frame/index.html
Internal choice: MODULE – III & IV	
Course outcomes At the end of the course ,the student will have the ability to	
CO1 Understand the language constructs and programming fundamentals of Verilog HDL	
CO2 Choose the suitable abstraction level for a particular digital design	
CO3 Construct Combinational and sequential circuits in different modelling styles using Verilog HDL	
CO4 Analyse and Verify the functionality of digital circuits/systems using test benches	

Course Title	**PCB DESIGN**				
Course Code	**23EI6OE1PD**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Pre-requisites: Basic electronics					
MODULE-I					**8 Hours**
Product development and planning Introduction: Characteristics of successful product development, who Designs and develops products, duration and cost of product development, the challenges of product development Development Processes and Organizations: A generic development process, concept development: the front-end process, adapting the generic product development process. Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning.					
MODULE-II					**8 Hours**
Product specification and selection Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.					

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. Concept Generation and Selection: The activity of concept generation clarifies the problem search externally, search internally, explore systematically, and reflect on the results and the process. Concept screening, concept scoring.

MODULE-III	**8 Hours**

Introduction to PCB Design, CAD and design Flow

Computer aided design and ORCAD design suite, PCB board Fabrication, PCB cores and layer stack up, PCB Fabrication process, Photolithography and chemical etching, Mechanical milling, layer registration, design files created by layout, overview of design flow, Creating a circuit design with capture, designing the PCB layout, design rule check

MODULE-IV	**8 Hours**

Project structures, Layout Environment and introduction to industry standards Project setup and schematic entry details, understanding the layout environment and toolset, Introduction to the standards organization, EIA, ANSI, IEEE, classes and types of PCB, standard fabrication allowances, PCB dimensions and tolerances, standard finished PCB thickness, copper tracing, etching and solder mask tolerances, standard hole dimensions

MODULE-V	**8 Hours**

Design for manufacturing and signal integrity:

Introduction to PCB assembly and soldering Process, Assembly process, soldering process, component placement and spacing for through hole devices, noise , distortion, Frequency response, issues related to PCB layout, EMI and Crosstalk, loop inductance, Electric fields and capacitive coupling, Ground planes and bounce.

Textbooks:

1.	Product Design and Development, Karl T. Ulrich University of Pennsylvania Steven D. Eppinger Massachusetts Institute of Technology
2.	“Complete PCB design using ORCAD capture and Layout”, Kraig Mitzner, Newnes-imprint of Elsevier
3.	"Printed circuit Board; Design and Technology” Walter C Bosshart, TATA McGraw- Hill

Reference books:

1.	**"Printed Circuit board: Design, fabrication, Testing and Assembly",** DR R S Khandpur, TATA McGraw- Hill.
2.	**"Printed Circuit Board Designers Reference Basics”,** Christopher T Robertson, Prentice Hall, Modern Semiconductor Design series

E References	
1.	https://nptel.ac.in/courses/108/108/108108031/
2.	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-682-prototyping-avionics-spring-2006/syllabus/

Internal choice: Module-II &V

Course outcomes

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

CO1: Define, understand and explain the concept of PCB design, CAD, Design flow, Layout, Manufacturing, Signal Integrity, product development and planning,

CO2: Apply the knowledge of basic systems to articulate the building blocks of the given analog/digital schematics to obtain layout.

CO3: Analyze interaction among various blocks of a given analog/digital schematic to assess manufacturability of the design and to issues relating to amalgamation of signals, Product specification and selection

Course Title	INDUSTRIAL SAFETY AND STANDARDS				
Course Code	23EI6OE1IS	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: General concepts of Industry environment

MODULE-I	8 Hours

Introduction: Fundamentals of industrial safety, importance of Safety in industry, causes of accidents and their preventive measures, types of accident, safety policy, safety committee and its activities, Different types of industries, Different types of safety systems and equipment's, safety terminology

Functional Safety : Introduction, Safety Functions and Safety-Related Systems, Functional safety standards- IEC 61508/IEC 61511, The overall Safety Life Cycle (SLS), safety requirements and safety functions, functional safety management, layers of protection, Safety Instrumentation System (SIS)

MODULE-II	8 Hours

Building Construction and safety : Introduction, Classification of building in the country, Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire Protection. Various types of occupancies and fire fighting techniques, Importance's of fire escapes with respect to their positioning, Reference to NBC part II fire construction and provisioning of fire fighting measures. Smoke management & HVAC.

Classification of Fire & Extinguishers - Classification of Fire and types of extinguishers, As per Indian standard and NFPA code, maintenance, method of operation. Techniques of fire extinction, Smothering, cooling and starvation. Types of fire extinguishing agents, Rating system for portable fire extinguishers, Limitation of fire extinguishers, Inspection requirement.

MODULE-III	**8 Hours**

Safety in Engineering Industries: Machine Operations & Guarding, Safety in the use of Machines, Safety precaution while using Hand Tools & Power Tools, Need for selection & Care of tools. Types of Guarding. Electrical Safety- Introduction, OSHA Standards on Electrical Safety, objectives of Safety and Security measures, types of electrical Hazards, primary and secondary electrical shocks, effects of electrical shocks on human body, approaches to prevent accident, and principals of electrical safety and first aid-cardio pulmonary resuscitation(CPR).

Occupational Health and safety:- meaning, health care services, quality of health services, occupational health services in places of employment, safety activities, suggestion for promoting occupational health and safety, difference between work related disease and occupational disease.

MODULE-IV	**8 Hours**

Environmental safety: Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards. Hazardous waste management in India-waste identification, characterization and classification technological options for collection, treatment and disposal of hazardous waste selection charts. Water pollutants-health hazards-sampling and analysis of water-water treatment – different industrial effluents and their treatment and disposal -advanced wastewater treatment – effluent quality standards and laws. Air pollutants – Pollution sources - automobile pollution-hazards of air pollution

MODULE-V	**8 Hours**

Industry Standards Overview :

Why are industrial standards important, Types of industrial standards, The development process for industrial standards, The role of standards organizations, Industry 4.0.

Introduction to IEC and its importance, IEC 61010-1: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. IEC 60079: Explosive Atmospheres Standards.Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – ISO 14001 – ISO 45001.

Text books:

1.	American National Standards Institute (ANSI): A guide to understanding standards
2.	"Industrial Process Automation Systems- Design and Implementation" , B.R. Mehta Y. Jaganmohan Reddy, 1st Edition, Elsevier, 2014

E-References	
1.	https://www.cstaricalcutta.gov.in/images/CTS%20Fire%20Tech%20and%20Ind.%20Safety%20Mgmt_CTS_NSQF-4.pdf
2.	https://sunspec.org/importanceindustrystandards/#:~:text=The%20main%20purpose%20for%20industry,to%2Duse%2C%20holistic%20solutions.
Internal choice: MODULE – II and V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand the role of organizations like OSHA, ANSI, ISO, and others in industrial safety.	
CO2: Identify and select appropriate extinguishers and categorize electrical hazard, risk and its mitigation.	
CO3: Identify potential hazards in industrial settings and prioritize safety measures to mitigate risks	

Course Title	**Project work-1**				
Course Code	**23EI6PWPJ1**	**Credits**	**2**	**L-T-P**	**0:0:2**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
➢ The Project work is carried out in a group of 2 to 4. ➢ The project will have problem statement identified with a thorough literature review or from an industry. ➢ Modelling and simulation of the proposed solution to investigate the dynamics of the physical model is suggested. ➢ Demonstration of the project and Result analysis is given importance. ➢ The project has the scope to be extended as Capstone project, with substantial experimentation and validation at the initial stage.					
Course outcomes: At the end of the course, the student will be able to					
CO1: Collect information/knowledge from across the various field of interest, interpret, identify, analyze, formulate the problem statement.					
CO2: Apply suitable knowledge/concepts acquired to develop appropriate solutions.					
CO3: Plan vital stages in development, use of modern tools/methods, multidisciplinary skill set, knowledge to implement the proposed work					
CO4: Work as an individual and (or) in a team towards the problem statement following best practices.					

CO5: Demonstrate a thorough and systematic understanding of project work through effective communication, documentation, and report submission.

Course Title	**PLC PROGRAMMING & SCADA**				
Course Code	**23EI6AEPLC**	**Credits**	**1**	**L-T-P**	**0:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Program Logic Controller, Basic programming					
Design a PLC ladder diagram/ functional block diagram to implement 1. Basic logic gates 2. Seal in Circuit, Sequential Control process 3. Liquid level Control in tank 4. Mixer process control 5. Automatic surface grinding process 6. Parking Garage counter 7. Control of traffic lights in one direction 8. Automatic Stacking of metal plates 9. Controlling multiple loads using one timer and the GEQ instruction. 10. Elevator Control 11. Bottle filling 12. Set Point Control 13. Temperature control/Motor Lock Out 14. Bin Sorting 15. Liquid Level Control 16. Batching Plant					
Text books:					
1.	"Programmable Logic Controllers", Frank D. Petruzella, McGraw-Hill Higher Education; 6th edition, 2022.				
Reference books:					
1.	"Industrial Automation from Scratch: A hands-on guide to using sensors, actuators, PLCs, HMIs, and SCADA to automate industrial processes", Olushola Akande, Packt Publishing Limited, 2023				
2.	"Advanced Industrial Automation: PLC programming in simplest way with 110 solved examples", Himanshu Kumar, Notion Press, 2020.				
3.	"Guide to Supervisory Control and Data Acquisition (SCADA) and Industrial Control				

	Systems Security- Recommendations of the National Institute of Standards and Technology", Stouffer, Keith & Falco, Joseph & Kent, Karen, 2006.
4.	"Mitsubishi FX Programmable Logic Controllers_ Applications and Programming" John Ridley - 2004, Newnes
E-References	
1.	https://www.abebooks.com/servlet/SearchResults?an=frank%20petruzella&bsi=30&sortby=17&tn=programmable%20logic%20controllers
2.	https://www.elsevier.com/books/industrial-process-automation-systems/mehta/978-0-12-800939-0
e–Learning :	
1.	https://nptel.ac.in/courses/108/105/108105062/#
2.	https://www.udemy.com/course/plc-programming-from-scratch/
Course outcomes At the end of the course, the student will have the ability to	
CO1: Implement the solutions to automate a process control system using modern tools.	
CO2: Engage in independent study and communicate effectively through presentations and reports.	