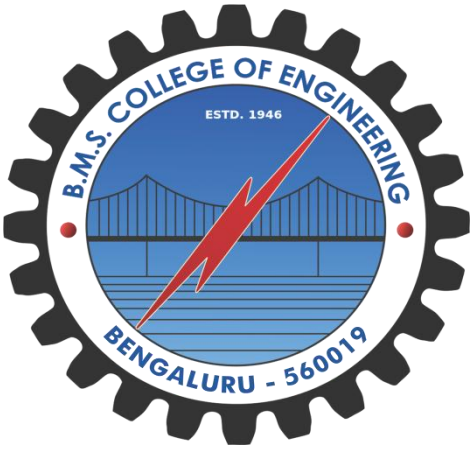

B.M.S. College of Engineering,
(Autonomous Institute)
Bull Temple Road, Bengaluru - 560019

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

Department of Electronics and Instrumentation Engineering

Scheme & Syllabus: III to VIII Semester

2021 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.

III Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22MA3BSTFN	Transform Calculus, Fourier Series And Numerical Techniques	BS	2:1:0	3	4	50	50	100
2.	22ES3PCECA	Electrical Circuit Analysis (Common for EIE, ETE)	PC	3:1:0	4	5	50	50	100
3.	22ES3PCAME	Analog Microelectronics (Common for MD, EIE)	PC	3:0:1	4	5	50	50	100
4.	22ES3PCDCS	Digital Circuits (Common for MD , ETE,EEE, EIE)	PC	3:0:1	4	5	50	50	100
5.	22EI3PCSMT	Sensors and Measurements Techniques	PC	3:0:1	4	5	50	50	100
6.	22MA3HSUHV	Universal Human Values	HS	0:1:0	1	2	50	50	100
7.	22EI3AEDAV	Data Acquisition and Virtual Instrumentation	AE	0:0:1	1	2	50	50	100
8.	22MA3HSSAK/ 22MA3HSBAK	Samskrutika Kannada / Balake Kannada	HS	1:0:0	1	1	50	50	100
9.	22EI3NCCLA	Cultural Activity	NCMC	-	-	2	-	-	PP/NP
Total				**15:3:4**	**22**	**31**	**400**	**400**	**800**

IV Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22MA4BSCPS	Complex Analysis, Probability And Statistical Methods	BS	2:1:0	3	4	50	50	100
2.	22ES4ESCST	Control Systems (Common for EEE, ECE , EIE, ETE)	ES	3:1:0	4	5	50	50	100
3.	22EI4PCSAS	Signals and Systems	PC	2:1:0	3	4	50	50	100
4.	22ES4PCLIC	Linear Integrated Circuits (Common for MD, EIE)	PC	3:0:1	4	5	50	50	100
5.	22ES4PCAPP	ARM Processor and Programing (Common for Electrical Cluster)	PC	3:0:1	4	5	50	50	100
6.	22EI4SRIN1	Seminar- Internship involving Social Activity/Technical Activity	SR	0:0:1	1	2	50	50	100
7.	22EI4AEMCP	Mathematics Concepts using Python	AE	0:1:0	1	2	50	50	100
8.	22CV4HSEVS	Environmental Studies	HS	1:0:0	1	1	50	50	100
9.	22MA4HSCPH	Constitution of India, Professional Ethics and Human Rights	HS	1:0:0	1	1	50	50	100
10.	22EI4NCPYA	Physical Activity	NCMC	-	-	2	-	-	PP/NP
Total				**15:4:3**	**22**	**31**	**450**	**450**	**900**

V Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22EI5PCCST	Communication Systems	PC	3:0:0	3	3	50	50	100
2.	22ES5PCDSP	Digital Signal Processing (Common for ECE, EIE)	PC	3:0:1	4	5	50	50	100
3.	22EI5PCPCS	Process Control Systems	PC	3:0:1	4	5	50	50	100
4.	22EI5PCTNI	Transducers and Instrumentation	PC	2:0:1	3	4	50	50	100
5.	22EI5PE1XX	Professional Elective -I	PE	3:0:0	3	3	50	50	100
6.	22EI5PWMP1	Mini Project -1	PW	0:0:2	2	4	50	50	100
7.	22EI5AEMI	Electro Magnetic Interference and Compatibility	AE	0:1:0	1	2	50	50	100
8.	22ES5HSPMF	Project Management and Finance (Common for EEE, ECE , EIE, ETE)	HS	2:0:0	2	2	50	50	100
9.	22EI5NCTWR	Technical Writing	NCMC	-	-	2	-	-	PP/NP
Total				**16:1:5**	**22**	**30**	**400**	**400**	**800**

Professional Electives

Area/Domain	Professional Elective- 1 V sem	Professional Elective- 2 VI sem	Professional Elective- 3 VII sem	Professional Elective- 4 VIII sem
Instrumentation	Aircraft Instrumentation (22EI5PE1AI)	Biomedical Instrumentation (22EI6PE2BI)	Automotive Electronics (22EI7PE3AE)	Analytical Instrumentation (22EI8PE4AN)
Automation	Industrial Process Instrumentation (22EI5PE1PI)	Internet of Things and Industrial IoT (22EI6PE2IT)	Computer Vision (22EI7PE3CV)	Cyber Security (22EI8PE4CS)
Data Processing and Intelligent Systems	Sensor Analytics and Edge Devices (22EI5PE1SE)	Digital Image Processing (22EI6PE2DP)	Robotics and Automation (22EI7PE3RA)	Data Science (22EI8PE4DS)
Programming Skills	C++ and Data Structures (22EI5PE1CD)	Artificial Intelligence and Machine Learning (22EI6PE2AM)	Multi Domain System Modelling (22EI7PE3MD)	Deep Learning (22EI8PE4DL)

VI Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22EI6PCPSA	Process Automation	PC	3:0:1	4	5	50	50	100
2.	22EI6PCESD	Embedded System Design	PC	3:0:1	4	5	50	50	100
3.	22EI6PCIDN	Industrial Data Networks	PC	2:0:0	2	2	50	50	100
4.	22EI6PCLOI	Laser and Optical Instrumentation	PC	2:0:0	2	2	50	50	100
5.	22EI6PE2XX	Professional Elective -2	PE	3:0:0	3	3	50	50	100
6.	22EI6OE1XX	Open Elective -1	OE	3:0:0	3	3	50	50	100
7.	22EI6PWMP2	Mini Project -2	PW	0:0:2	2	4	50	50	100
8.	22EI6SRIN2	Internship Based Seminar	SR	0:0:1	1	2	50	50	100
9.	22EI6HSISS	Industrial Safety and Standards	HS	1:0:0	1	1	50	50	100
10.	22EI6NCPDC	Personality Development and Communication	NCMC	-	-	2	-	-	PP/NP
Total				**17:0:5**	**22**	**29**	**450**	**450**	**900**

Open Electives

Area/Domain	Open Elective- 1 VI Sem	Open Elective- 2 VII Sem	Open Elective- 3 VIII Sem
Instrumentation	Smart Sensors (22EI6OE1SS)	Instrumentation for Building Automation (22EI7OE2BA)	Instrumentation for Smart Cities (22EI8OE3SC)
Automation	Sensors and Instrumentation (22EI6OE1SI)	Product Design Technology (22EI7OE2PD)	Carbon Initiative for Climate (22EI8OE3CC)

VII Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22ES7BSBFE	Biology for Engineers (Common for EEE, ECE, ETE, EIE)	BS	1:0:0	1	1	50	50	100
2.	22EI7PCVLI	VLSI Design	PC	3:0:1	4	5	50	50	100
3.	22EI7PE3XX	Professional Elective -3	PE	3:0:0	3	3	50	50	100
4.	22EI7PWPW3	Project -3	PW	0:0:3	3	6	50	50	100
5.	22EI7OE2XX	Open Elective -2	OE	3:0:0	3	3	50	50	100
6.	22ES7HSIPL	Intellectual Property Rights and Cyber Law (Common for EIE , EEE)	HS	2:0:0	2	2	50	50	100
7.	22EI7NCMC1	MOOCs Course -1	NCMC	-	-	2	-	-	PP/NP
Total				**12:0:4**	**16**	**22**	**300**	**300**	**600**

VIII Semester Scheme

Sl. No	Course Code	Course Title	Type	L:T:P	Credits	Hours	CIE	SEE	Total
1.	22EI8PE4XX	Professional Elective -4	PE	3:0:0	3	3	50	50	100
2.	22EI8PWPW4	Project -4	PW	0:0:6	6	12	50	50	100
3.	22EI8OE3XX	Open Elective -4	OE	3:0:0	3	3	50	50	100
4.	22ES8HSIFE	Innovation for Entrepreneurship (Common for EEE, ECE, EIE, ETE)	HS	2:0:0	2	2	50	50	100
5.	22EI8SRIN3	Seminar on Internship	SR	0:0:2	2	4	50	50	100
7.	22EI8NCMC2	MOOCs Course - 2	NCMC	-	-	2	-	-	PP/NP
Total				**8:0:8**	**16**	**26**	**250**	**250**	**500**

Distribution of credits among various Curricular Components

Curricular Component/ Semester	I	II	III	IV	V	VI	VII	VIII	Total
Basic Science Course (BS)	8	8	3	3			1		**23**
Engineering Science Course (ES)	10	10		4					**24**
Professional Core Course (PC)			16	11	14	12	4		**57**
Professional Elective Course (PE)					3	3	3	3	**12**
Open Elective Course (OE)						3	3	3	**9**
Project/ Mini-Project (PW)					2	2	3	6	**17**
Seminar on Internship (SR)				1		1		2	
Humanities and Social Sciences, Management Course (HS)	1	1	2	2	2	1	2	2	**13**
Ability Enhancement Course / Mandatory Course(AEC)	1	1	1	1	1				**5**
Non-Credit Mandatory Course (NCMC)	-	-	NC	NC	NC	NC	NC	NC	**6 Modules**
Total Credits	**20**	**20**	**22**	**22**	**22**	**22**	**16**	**16**	**160**

III Semester

Course Title	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES				
Course Code	22MA3BSTFN	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

COURSE OBJECTIVES: The purpose of the course is to facilitate the learners to:

- Appreciate the importance of Series, Transforms and Numerical Techniques in Engineering Problems.
- Acquire the knowledge of Series, Transforms and Numerical Techniques to apply them in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

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

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skills.

MODULE -I	08 Hours

LAPLACE TRANSFORMS:

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace Transform of periodic functions (statement only) and MODULE-step function –problems. Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations.

Self-study: Solution of simultaneous first-order differential equations.

MODULE -II	08 Hours

FOURIER SERIES:

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Self-study: Convergence of series by D'Alembert's Ratio test and Cauchy's root test.

MODULE -III	**08 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.

Self-Study: Convolution Theorem and Parseval's Identity - Problems.

MODULE -IV	**08 Hours**

NUMERICAL SOLUTIONS OF PDE:

Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt explicit formula and Crank-Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.

Self-Study: Solution of Poisson equations using standard five-point formula.

MODULE -V	**08 Hours**

CALCULUS OF VARIATIONS:

Definition, Variation of a functional, Euler's equation, variational problems.

Applications: Hanging cable problem, Brachistochrone problem.

Z-TRANSFORMS:

Definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems-problems. Inverse z-transform and applications to solve difference equations.

Self- Study: Geodesics on a plane, Minimum Surface area of revolution.

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.Newyork, Latest ed.
5.	Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic 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/
3.	http://www.bookstreet.in.
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 Transform Techniques, optimization and Finite Difference Methods to solve engineering problems.

CO2: Analyze Engineering Application Problems using the concepts of Transform Techniques, optimization and Finite Difference Methods.

CO3: Demonstrate the importance of Transform Techniques, optimization and Finite Difference Methods in engineering using programing tools.

Course Title	**ELECTRICAL CIRCUIT ANALYSIS (Common for EIE, ETE)**				
Course Code	**22ES3PCECA**	**Credits**	**4**	**L-T-P**	**3:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites:

MODULE -I	**08 Hours**

Basic Concepts of Circuits and analysis:

Practical sources, Source transformations, Loop and node analysis with linearly dependent and independent sources for DC and AC circuits, Analysis of network involving concepts of super

node, super mesh. Network reduction using Star to Delta transformation and Delta to Star transformation	
MODULE -II	**08 Hours**
Network Topology and Series and Parallel Resonance: Graph of a network, Concept of tree and Co-tree, Incidence matrix, tie-set, tie-set schedule & cutset, cut-set schedule, Formulation & solution of equilibrium equations. Resonant Circuits: Series and parallel resonance, Frequency response of series and parallel circuits, Q factor, Bandwidth.	
MODULE- III	**08 Hours**
Network Theorems: Superposition, Reciprocity, Millman's, Thevenin's and Norton's theorems; Maximum power transfer theorem.	
MODULE IV	**08 Hours**
Transient Behaviour and Initial Conditions: Behaviour of circuit elements under switching condition and their representation, Evaluation of Initial and final conditions in RL, RC and RLC circuits for DC conditions. Review of Laplace transforms, Waveform Synthesis, Initial and Final value theorems, Step, Ramp and Impulse responses, solution of simple R-L, R-C, R-L-C networks for DC excitations using Laplace transforms.	
MODULE V	**08 Hours**
Two Port Network Parameters Definition of Z, Y, T and h parameters, symmetric and reciprocity conditions, modelling of two port network parameters, relationship between parameters sets.	
Text books:	
1.	"Network Analysis", M.E.Vanvalkenburg, PHI/ Pearson Education, 3rd Edition. Reprint 2002.
2.	"Network and systems ", Roy Choudhury, 2nd edition, 2006 reprint, New Age International Publications.
3.	Theory and Problems of Electric Circuits", Schaum's Series, 2nd Edition McGraw Hill
Reference books:	
1.	"Engineering Circuit Analysis", Hayt, Kemmerly and Durbin, TMH 6th 2002. Hill.
2.	"Network analysis and Synthesis", Franklin F. Kuo, Wiley Edition.

3.	"Analysis of Linear Systems", David K. Cheng, Narosa Publishing House, 11th reprint, 2002.
4.	"Circuits", Bruce Carlson, Thomson learning, 2000. Reprint 2002.
5.	Network analysis and Synthesis", D. Anand Kumar, PHI Learning, 2019.
E-References	
1.	Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur.
2.	Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
3.	www.electrodiction.com/circuit-theory.
e–Learning :	
1.	https://swayam.gov.in/nd1_noc19_ee36/preview
2.	http://elearning.vtu.ac.in/06ES34.html
3.	https://www.coursera.org/course/circuits
Internal choice: MODULE –	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Understand the basic concepts related to various types of Electrical networks	
CO2: Apply the suitable network theorem /topology for the given Electrical circuit to obtain the desired electrical parameters	
CO3:Analyse the switching conditions of the given electrical circuit to obtain time domain response	
CO4: Interpret the given electrical network and obtain the quality parameter with reasoning	
CO5: Investigate two port network to represent the parameter in different forms	

Course Title	**ANALOG MICROELECTRONICS (Common for MD, EIE)**				
Course Code	**22ES3PCAME**	**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					**08 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	**08 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	**08 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	**08 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	**08 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 transconductance 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

IC Biasing: Current sources, current mirror and current steering circuits: The basic MOSFET current source, MOS current steering circuits

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 on Biomedical Applications

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 Electronic Circuits**, the student will have the ability to	
CO1: Ability to apply the knowledge of KVL and KCL to obtain voltage /current/waveform at different points in analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers.	
CO2: Ability to analyse analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers etc. to obtain voltage /current/waveform at different points for given specifications.	
CO3: Ability to design analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers etc. to obtain voltage /current/waveform at different points for given specifications.	
CO4: Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis and Present a report	
CO5: Ability to formulate, design, implement, analyse, document and demonstrate an application using analog Electronic components through an open ended experiment, Document and present the same.	
CO6: Engage in independent learning on Analog electronic component.	

Course Title	DIGITAL CIRCUITS (Common for MD , ETE,EEE, EIE)				
Course Code	22ES3PCDCS	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites:

MODULE-I	08 Hours

Introduction: Review of Boolean algebra, logic gates**.**

Simplification of Boolean functions: Three Variable, Four Variable-K– Maps, The Tabulation Method, Design with Basic gates, NAND gates and NOR gates.

Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles of Description. Introduction to test bench

MODULE-II	08 Hours

Arithmetic Circuits: Introduction, Half adder, Half subtractor,Full adder, Full subtractor, Parallel Adders (Carry Look Ahead Adder and Ripple carry adder), Decimal Adder.

Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description

MODULE-III	08 Hours

Combination Logic Circuits: Code conversion, Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays (PLAs). Modeling using data flow description.

MODULE-IV	08 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.

Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Combinational and Sequential Circuits.

MODULE-V	08 Hours

Registers and Counters with Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of Combinational and Sequential Circuits- Shift Registers, Ripple Counters, Design of Synchronous Counters.

Lab Experiments:

1. Applications of IC 7483 (Adders, Subtractors and Comparators)
2. Multiplexers (using Gates and IC) and their applications.

3. Decoders/DeMultiplexers (using Gates and IC) and their applications.
4. BCD to Decimal decoder using 7-segment display .
5. Verification of MSJK Flip-flop (using Gates and IC 7476).
6. Asynchronous counters (using ICs 7476,7490,7493).
7. Synchronous Counters (using ICs 7476, 74190/74192).
8. Shift registers and their applications (using ICs 7476, 7495).

Text books:

1.	Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Education
2.	Verilog HDL –Samir Palnitkar
3.	Digital Principles and Design- Donald Givone, Tata Mc Graw Hill

Reference books:

1.	Digital Design : Principles and Practices 4th Edition,John F. Wakerly
2.	Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
3.	Digital Logic Applications and principles- John Yarbrough, Pearson Education
4.	HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint,Dreamtech press.

E-References

1.	http://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/

e–Learning :

1.	https://nptel.ac.in/courses/108105113/
2.	https://nptel.ac.in/courses/Verilog fundamentals

Internal choice: MODULE – II & IV

Course outcomes

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

CO1: Understand, define the fundamentals

CO2: Apply the knowledge for simplification and optimization of digital concepts.

CO3: investigate and simulate a digital circuit for given specifications.

CO4: Design and analyze digital circuits to arrive at suitable conclusions

CO5: Conduct experiments using digital ICs and Verilog for a given application/problem statement

Course Title	SENSORS AND MEASUREMENT TECHNIQUES				
Course Code	22EI3PCSMT	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		
Prerequisites:					

MODULE I	08 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.	
MODULE II	**08 Hours**
Physical Principles of Sensing: Capacitance, magnetism, Induction, Resistance, Piezoelectric Effect, Hall effect, Thermoelectric effect, Sound waves, Temperature and thermal properties of materials, Heat transfer. **Displacement and Level Sensors**: Inductive, Magnetic and Optical, Acceleration: Accelerometers – Seismic Sensors. Force and Strain: Strain Gauge, Pressure sensors.	
MODULE III	**08 Hours**
Acoustic sensor: Resistive and Fiber-optic microphones, Humidity and Moisture sensor: Concept of Humidity, Thermal conductivity and Optical, Hygrometers, Light Detectors: Photodiode, Phototransistor, Photoresistor Radiation Detectors: Scintillating Detectors and Ionization Detectors	
MODULE IV	**08 Hours**
Temperature sensor: Pyroelectric Effect, Coupling with object, Static & Dynamic heat exchange, RTD, Thermistors, Thermocouple circuits, Optical Temperature sensor, Multi sensor arrays	
MODULE V	**08 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:

Application of following sensors using electronic components

1. Light sensor
2. Linear variable position transducer
3. Temperature dependence of diodes
4. Microphone to speaker amplifier circuit
5. Water level indicator
6. IR sensor and Photodiode
7. Piezo Electric sensor
8. Heat sensor
9. Strain gauge
10. Thermistor
11. Mini project to build an instrument on Multisim platfor.m Verify few parameters from the data sheet of sensors

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
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 on **Sensors and Measurements**, the student will have the
CO1: Understanding the concepts of sensing and building blocks of measuring systems
CO2: Integrated the knowledge of physics behind sensors and electronics conversion in a measurement system
CO3: Analyse the performance of measurement system and sensor characteristics
CO4: Conduct investigation to provide solution to specific measurement needs
CO5: Interpret the analog circuits for signal conditioning to the given physical or chemical measuring parameters
CO6: Involve independently and demonstrate concept of sensing and measuring system.

Course Title	**UNIVERSAL HUMAN VALUES**				
Course Code	**22MA3HSUHV**	**Credits**	**01**	**L-T-P**	**0:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

COURSE OBJECTIVES: To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

MODULE -I

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

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

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 Order- from 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

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

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)
Internal choice: MODULE	
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	**22EI3AEDAV**	**Credits**	**1**	**L-T-P**	**0:0:1**

Lab Experiments:

1. Development of basic algorithms in LabVIEW.
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. Build a VI to find factorial of number, permutations and combinations.
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. Different wave generation and detection.
7. Data Acquisition from various sensors using DAQ Cards- Finite and continuous buffered acquisition mode.
8. Building a VI to simulate and study the performance of First order and second order systems.
9. Generation of HTML report using LabVIEW.
10. 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.

Course Title	ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ				
Course Code	**22MA3HSSAK**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು :

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳ ಸಾದಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ.

ಭೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching – Learning Process – General Instructions):

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

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇವತ್ತಿನ ತಂತ್ರಜ್ಞಾದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು - ಅಂದರೆ ಕವಿ - ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆ ಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂದಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು. ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶನಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಟಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಕಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸುವುದು.

ಘಟಕ - 1	**3 Hours**

ಲೇಖನಗಳು:

1. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ.
2. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ - ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ - 2	**4 Hours**

ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ:

1. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕ ಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಜೇಡರದಾಸಿಮಯ್ಯ , ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.
2. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸರು
   ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .

ಘಟಕ - 3	**3 Hours**

ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ:

1. ಕುರುಡು ಕಾಂಚಾಣ : ದಾ. ರಾ. ಬೇಂದ್ರೆ .
2. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .

ಘಟಕ - 4	**3 Hours**

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ:

ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ: ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್

ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ: ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
<u>ಘಟಕ - 5</u>	**2 Hours**
ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ: ಕನ್ನಡ - ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
ಪಠ್ಯ ಪುಸ್ತಕ:	
1.	ಡಾ. ಹಿ. ಚೆ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.
Course outcomes	
CO1: ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.	
CO2: ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರಾ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡುತ್ತದೆ.	
CO3: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ, ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗು ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.	

Course Title	ಬಳಕೆ ಕನ್ನಡ				
Course Code	**22MA3HSBAK**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. To enable learners to Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement and train the learners for correct and polite conservation.

ಭೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching – Learning Process – General Instructions):

These are sample Strategies; which teacher can use to accelerate the attainment of the course

outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕವನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿ ಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧ ಪಟ್ಟ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣ ಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು . ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯ ಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

ಘಟಕ - 1	**2 Hours**

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವ್ಯಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯ ಸೂಚಕ / ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - **Personal Pronouns, Possessive Forms, Interrogative words**

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.

ಘಟಕ - 2	**3 Hours**

1. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣ ಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, quantitative and colour adjectives, numerals.
2. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - (ಅ, ಅದು, ಅವು, ಅಲ್ಲಿ) predictive forms, locative case.

ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು,

	ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .
ಘಟಕ - 3	**3 Hours**
1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative cases, and numerals. 2. ಸಂಖ್ಯಾವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers.	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು .
ಘಟಕ - 4	**3 Hours**
1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು. Permission, Commands, encouraging and Urging words (Imperative words and sentences) 2. "ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯ ಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು. – Helping verbs “iru and iralla”, corresponding Future and negation verbs.	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
ಘಟಕ - 5	**4 Hours**
1. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮತ್ತು ರಾಜ್ಯದ ಬಗ್ಗೆ ಕುರಿತಾದ ಇತರ ಮಾಹಿತಿಗಳು. Karnataka State and General Information about the State. 2. ಕನ್ನಡ ಭಾಷೆ ಮತ್ತು ಸಾಹಿತ್ಯ. Kannada Language and History. 3. Kannada Language Script Part – 1	
ಭೋದನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪ್ಟ್ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವೀಡಿಯೋಗಳನ್ನು ಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆ ಚಟುವಟಿಕೆಗಳ ಮುಕಾಂತರ ಚರ್ಚಿಸುವುದು.
ಪಠ್ಯ ಪುಸ್ತಕ:	
1.	ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಬಳಕೆ ಕನ್ನಡ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.
Course outcomes	
CO1: To create an awareness regarding the necessity of learning local language for a comfortable living and to know more about Kannada culture and literature.	
CO2: To develop proper speaking, reading and writing skills in Kannada.	

CO3: To engage as a member of a team and enhance the skill in group communication and presentation.

Course Title	**CULTURAL ACTIVITY**				
Course Code	**22EI3NCCLA**	**Credits**	**-**	**L-T-P**	**--**

The college provides opportunity for students to associate with a large number of Culturalactivities.

Sample Affinity groups are listed below:

- Ninaad- Indian Music Team
- The Grove House- The Western Music Team
- Paramva- The Contemporary DanceTeam
- Danz Addix- The Western Dance Team
- Panache- The Fashion Team
- Pravrutti- The Theatre Team
- Photography Club
- Chirantana- Kannada Sangha
- Fine Arts Club
- Inksanity- The Literary Club
- Samskrithi Sambhrama – The Folk Dance Club
- VAK- The MCeeing Club
- Rotaract
- Bullz Racing
- TEDx BMSCE
- Quiz Club

Students regularly associated with ANY one of the above activities, and certified by theconcerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in cultural events organized by the department.

IV Semester

Course Title	COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS (Common to AS/ME /EEE/ECE/ET/ML/CIVIL/EIE)				
Course Code	22MA4BSCPS	Credits	3	L-T-P	2:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

COURSE OBJECTIVES: The goal of the course is to:

- Appreciate the importance of Complex Analysis, Special Functions, Probability and Statistics in Engineering.
- Acquire the knowledge of Complex Analysis, Special Functions, Probability and Statistics applied in their core domain.
- Improve their Mathematical thinking and acquire skills required for sustained lifelong learning.

TEACHING-LEARNING PROCESS (General Instructions):

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

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Encourage the students for group learning to improve their creative and analytical skill.

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, Problems. Conformal mapping: $w = z^2$ and $w = z + \frac{k^2}{z}\ (z \neq 0)$.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process: Chalk and Board, Problem based learning / Presentation

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 $P_n(x)$, generating function for $P_n(x)$. Legendre polynomials, Rodrigue's formula (without proof) - Problems.

Teaching-Learning Process: Chalk and Board, Problem based learning / Presentation

MODULE -III	8 Hours

STATISTICAL METHODS:

Correlation and regression - Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis: lines of regression, angle between two regression lines - problems.

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

Teaching-Learning Process: Chalk and Board, Problem based learning / Presentation

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- problems (derivations for mean and standard deviation for Poisson distribution only)-Illustrative examples.

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

Teaching-Learning Process: Chalk and Board, Problem based learning / Presentation

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 as a test of goodness of fit.

Teaching-Learning Process: Chalk and Board, Problem based learning / Presentation

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: Analyze the engineering data/problems using special functions, complex variables and statistical methods.	
CO3: Demonstrate the importance of complex variables, special functions and statistical methods using programing tools.	

Course Title	CONTROL SYSTEMS				
Course Code	22ES4ESCST	Credits	4	L-T-P	3:1:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Linear Circuit Analysis, Engineering Mathematics I & II, Advanced Mathematics preferred.

MODULE-I	08 Hours

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

Mathematical Modelling of Linear Systems: Transfer functions, Mechanical Systems, Analogous Systems, Block diagram, Signal Flow graph, Transfer Functions of Lag & Lead Compensators.

MODULE-II	08 Hours

Controllers & Time Response Analysis: Step response of first order, second order systems, response specification, steady state error and error constants. Effect of PI, PD and PID controllers on the time response of the system.

MODULE-III	08 Hours

Stability Analysis: Concept of stability, RH criterion, applications of RH criterion with limitations.

Root locus technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot

MODULE-IV	08 Hours

Frequency Response Analysis: Frequency domain specification, Polar plots, Nyquist plot, Stability Analysis using Nyquist criterion, Bode plots, GM and PM, Relative stability

MODULE-V	08 Hours

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

Text books:

1.	Control Engineering - Nagrath & Gopal, New Age International Publishers
2.	Engineering control systems – Norman S. Nise, John WILEY & sons, fifth Edition

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-control-system/#practical-examples-of-open-loop-control-system
3.	http://www.facstaff.bucknell.edu/mastascu/eControlHTML/CourseIndex.html
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 the concepts related to control systems	
CO2: Apply the knowledge of engineering fundamentals to obtain transfer function of a system	
CO3: Analyse the behaviour of a given LTI system	
CO4: Investigate the stability and/or design a given system using time/ frequency domain techniques.	
CO5: Interpret the response of a linear system using modern tools and communicate effectively.	

Course Title	**SIGNALS AND SYSTEMS**				
Course Code	**22EI4PCSAS**	**Credits**	**3**	**L-T-P**	**2:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
MODULE-I					**08 Hours**
Signals -Definition of Signals, Classification of Signals, Basic Operations on Signals: Operations Performed on the Independent and Dependent Variable, Precedence Rule, Elementary Signals					
MODULE-II					**08 Hours**
Systems -Definition of Systems, System Viewed as Interconnection of Operations, Properties of Systems.					
MODULE-III					**08 Hours**
Time domain representations of Linear Time Invariant Systems : Introduction: Impulse response representation of LTI systems, Properties of impulse response representation of LTI systems, Differential and Difference equation representation for LTI systems, Block diagram representation of Continuous time system					

MODULE-IV	08 Hours
Application of Fourier Representation for signals: Discrete Time Fourier Series, Properties of DTFS, Discrete Time Fourier Transform, Properties of DTFT, Frequency response of LTI Systems, Convolution and Modulation with Mixed Signal classes, Sampling, Application of DTFT.	
MODULE-V	**08 Hours**
Applications of z-transforms: Transform Analysis of LTI Systems using Z-transform, Relating the transfer function and difference equation, Causality and stability, Inverse Systems, Determining the frequency response from poles and zeros, Computational structures for implementing Discrete Time Systems, Unilateral Z-transforms and solution of difference equations.	
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.	Benoit Boulet " Fundamentals of Signals and Systems" Thomson, 2006
e–Learning :	
1.	NPTEL lecture video on Signals and Systems by Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-andhtml
2.	NPTEL online course modules – By Prof. Aditya K. Jagannatham | IIT Kanpur Principles of Signals and Systems - Course (nptel.ac.in)
Internal choice: MODULE –	
Course outcomes At the end of the course, the student will have the ability	
CO1: Understand the basic principles of signals/system .	
CO2: Apply the knowledge of mathematics to obtain desired parameters of a given signals/system.	
CO3: Analyze the given system in time domain and frequency domain to arrive at a valid conclusion .	
CO4: Design an impulse response of a linear time invariant system to obtain the desired response.	
CO5 : Investigate using open source software to model continuous and discrete time systems.	

Course Title	LINEAR INTEGRATED CIRCUITS				
Course Code	22ES4PCLIC	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basic concepts of analog electronic circuits and their analysis

MODULE -I	08 Hours

Operational Amplifier Characteristics and Basic Applications: Introduction, Internal block diagram of OP-amp, DC and AC Characteristics – definitions, limitations and errors in practical circuits, Basic Closed loop configurations, Frequency Compensation. DC Applications: V to I, and I to V converters, Application in series voltage regulator, Example designs with LM723. Instrumentation Amplifiers (IA), IA Chips. AC Applications: Inverting and Non-inverting AC amplifiers, Precision half wave and full wave rectifiers, Sample and Hold circuits.

MODULE -II	08 Hours

Comparators and Waveform Generators: Introduction, Comparator, Schmitt Trigger, Square wave generator using Astable and Monostable Multivibrators, Triangular waveform generator, Sinusoidal oscillators - RC phase-shift and Wien bridge oscillators.

MODULE -III	08 Hours

Active Filters: Introduction, Passive versus Active Filters, Differentiator and Integrator Circuits, Active Filters: First and Second order Low pass and high pass filters, Realization of higher order filters, Notch filter for power line noise removal, All pass filter-phase shift lead and lag types.

MODULE -IV	08 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, and Types of ADCs - Counter type, Successive Approximation, Single and Dual slope, Flash, and Sigma – delta. Applications of DACs and ADCs. Data Acquisition systems

MODULE- V	08 Hours

Phase Locked Loops: Basic Principles, Analog and Digital Phase detectors, Voltage Controlled Oscillator, LPF. Applications of PLL in Frequency multiplication, division and translation.

Lab 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. Square waveform generator using AMV
6. Triangular waveform Generator
7. RC- Phase shift and Wien bridge Oscillators
8. First and Second order low pass and high pass filter
9. Second Order Low pass filter
10. Data Acquisition using myDAQ

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 & IV

Course outcomes

A At the end of the course on **Linear Integrated Circuits**, the student will have the

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**				
Course Code	**22ES4PCAPP**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
MODULE-I					**08 Hours**
Overview of computing systems: Basic structure of computers- function MODULEs of a computer, bus structure, performance of the processor, memory location and addresses, memory and I/O systems , basic processing MODULE, pipelining, computer peripherals					
MODULE-II					**08 Hours**
ARM Processor fundamentals -RISC and ARM Design philosophy, ARM core Dataflow model, programming model, processor states and operating modes, exceptions and interrupts, ARM pipeline, ARM instruction set, Assembler rules and Directives, load/store architecture, ARM-THUMB interworking, programming					
MODULE-III					**08 Hours**
Embedded C codes- overview of C compiler and optimization, Basic C data types, Local variable types, C looping and structures, Registrar allocation, function calls, pointer aliasing, Writing and optimizing assembly codes, mixing C and Assembly, programming, instruction scheduling					
MODULE-IV					**08 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					
MODULE-V					**08 Hours**
Application of ARM controller LPC 2148/1768.: Memory map, memory and I/O mapped					

peripherals- ADC, DAC and UART, 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.	Computer Organization and Architecture, Carl Hamacher, Zvonko Vranesic, McGraw-Hill,2001
2.	ARM System Developer's Guide, Sloss, Symes, WrightMorgan Kaufmann Publishers, Elsevier,2005
3.	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

Course Title	**SEMINAR- INTERNSHIP INVOLVING SOCIAL ACTIVITY/ TECHNICAL ACTIVITY**				
Course Code	**22EI4SRIN1**	**Credits**	**1**	**L-T-P**	**0:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
Internship involving Social Activity Students will engage themselves in social activities for about three weeks to earn AICTE recommended activity points during semester break. The students need to present their work for evaluation. Internship for 4-6 weeks duration with NGO / Social Activity OR **Technical Activity** implemented during semester break after 2nd or 3rd semester and evaluated through seminar and report in the 4th semester					

Course Title	**MATHEMATICS CONCEPTS USING PYTHON**				
Course Code	**22EI4AEMCP**	**Credits**	**1**	**L-T-P**	**0:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Mathematics and Computer Basic					
MODULE-I					
Introduction to numpy; matplotlib; Plotting of Functions; The Text Editor for mathematical equations					
MODULE-II					
Elementary Functions; Calculus (Integration, Differentiation); Defining Functions; Develop Code for a given equation; Write the equation for a given code					

MODULE-III
Probability and Statistics; Discrete Probability Functions (Binomial, Poisson); Continuous Probability Functions (Uniform, Normal, Exponential); Cumulative distribution functions
MODULE-IV
Generation of periodic signals from Fourier Series; Fourier Transform of signals (Periodic and Non-periodic);
MODULE-V
Differential equation; Pole-zero plot; Magnitude response; Impulse response; Step response; System classification;

Course Title	**ENVIRONMENTAL STUDIES**				
Course Code	**22CV4HSEVS**	**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	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS**				
Course Code	**22MA4HSCPH**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Course Objectives:

The objectives of the course are:

- To educate students about the country's highest law.
- To respect human dignity and protect people's rights from discrimination.

- To discuss about risk management, workplace safety, and increase understanding of concerns pertaining to the profession.

Teaching-Learning Process (General Instructions):

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Innovative lecture methodologies to be adapted to improve the teaching and learning process.
- Short videos for better understanding and group discussion.
- Encourage collaborative (Group Learning) learning in the class.
- Ask Higher Order Thinking (HOT) questions in the class, which promotes critical thinking.
- Classroom discussions focused on case studies to help students strengthen their analytical skills and thinking abilities, such as the capacity to assess, generalise, and analyse knowledge rather than just recollect it.

MODULE I	**3 Hours**

Introduction to Indian Constitution

Framing of the Indian constitution: Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India, Fundamental Rights and its limitations. Fundamental Duties and their significance. Directive Principles of State Policy: Importance and its relevance. Case Studies.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation.

MODULE II	**3 Hours**

Union Executive and State Executive

The Union Executive – The President and the Vice President, the Prime Minister and

The Council of Ministers. The Union Parliament – Lok Sabha & Rajya Sabha.

The Supreme Court of India.

State Executive – The Governors, the Chief Ministers and the Council of Ministers. The State Legislature – Legislative Assembly and Legislative Council. State High Courts.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation.

MODULE III	**3 Hours**

Election Commission of India, Amendments and Emergency Provisions

Election Commission of India – Powers & Functions – Electoral Process in India.

Methods of Constitutional Amendments and their Limitations.

Important Constitutional Amendments – 42nd, 44th, 61st, 74th, 76th, 77th, 86th and 91st.

Emergency Provisions. Case Studies.

Teaching-Learning Process: Chalk and talk method / Power Point Presentation

MODULE IV	**3 Hours**

Human Rights

Human Rights – Meaning and significance, Types Human Rights, Powers and Functions of National and State Human Rights Commission of India. Human rights in constitution of India.

MODULE V	**3 Hours**

Professional Ethics

Scope and Aims of Engineering Ethics, Responsibilities of Engineers and impediments to Responsibilities. Honesty, Integrity and Reliability; Risks – Safety and Liability in Engineering. Case Studies

Text books:

1.	"An Introduction to Constitution of India and Professional Ethics" by Merunandan K.B. and B.R. Venkatesh, Meragu Publications, 3rd edition, 2011.
2.	"Constitution of India & Professional Ethics & Human Rights" by Phaneesh K. R., Sudha Publications,10th edition, 2016.

Reference books:

1.	"V.N. Shukla's Constitution of India" by Prof (Dr.) Mahendra Pal Singh (Revised), Eastern BookCompany, Edition: 13th Edition, 2017, Reprint 2019.
2.	"Ethics in Engineering" by Martin, W. Mike.,Schinzinger, Roland., McGraw-Hill Education; 4th edition (February 6, 2004) .

E-References

1.	https://www.smartzworld.com/notes/constitution-of-india-and-professional-ethics-notes-vtu-cip-pdf/
2.	https://legalstudymaterial.com/constitution-of-india/

SEE Exam Question paper format

50 Multiple Choice Questions

Total Marks 50X2=100

Course outcomes

At the end of the course on **Constitution of India, Professional Ethics and Human Rights**, the Studentwill have the ability to

CO1: Recognize the significance of the Indian Constitution as the supreme legal authority.

CO2: Analyse human rights theories and concepts.
CO3: Apply the principles of moral obligations and duties to safeguard the public's welfare and safety.

Course Title	**PHYSICAL ACTIVITY**				
Course Code	**22EI4NCPYA**	**Credits**	**-**	**L-T-P**	**--**

The college provides opportMODULEy for students to associate with a large number of physicalactivities.

Sample activities are listed below:

- Civil Defense/ Self-defense through Karate
- NCC
- Sports for Beginners

  Badminton/ Kho-Kho/ Chess/ Net Ball/ Football/ Table Tennis/ Handball/ Cricket/ Hockey/ Volleyball/ Kabaddi/ Basket Ball/Throw Ball
- Sports for Regular Players:

  Tennis / Athletics / Ball Badminton / Baseball / Billiards & Snookers / Body Building / Roller Skating / Rugby / Softball / Swimming / Yachting / Gymnastic / Archery / Cycling / Equestrian / Fencing / Golf / Karate / Kayaking & Canoeing /Power-lifting / Rowing / Shooting / Squash / Weight Lifting / Boxing / Wrestling / Judo

Students regularly associated with ANY one of the above activities, and certified by the concerned faculty in-charge, shall be awarded a Pass Grade in the Course.

Students who are not associated with the above affinity groups, shall participate in the events organized by the department:

- Yoga for Beginners

Full/Half-Marathon

V Semester

Course Title	COMMUNICATION SYSTEMS				
Course Code	22EI5PCCST	Credits	3	L-T-P	3:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

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

MODULE -I	**8 Hours**

Amplitude Modulation:

Time-Domain Description, Frequency domain description, Generation of AM waves, Detection of AM waves, Generation of DSBSC waves, Coherent Detection of DSBSC Modulated waves. Costas receiver, Quadrature Carrier multiplexing, Comparison of amplitude modulation techniques, frequency translation, FDM.

MODULE -II	**8 Hours**

Angle Modulation:

Basic Concepts, Frequency Modulation, Spectrum Analysis of sinusoidal FM wave, NBFM, WBFM, Constant Average power, Transmission bandwidth of FM waves, Generation of FM waves, Direct FM, demodulation of FM waves, frequency discriminator, ZCD, phase locked loop (1st order) comparison of AM and FM.

MODULE -III	**8 Hours**

Noise In Analog Modulation Systems:

Signal-to-noise ratios, AM receiver model, DSBSC receiver, noise in AM receivers using envelope detection, threshold effect, FM receiver model, noise in FM reception, FM threshold effect, pre-emphasis and de-emphasis in FM systems

MODULE -IV	**8 Hours**

Pulse Modulation: Sampling theorem for low-pass and band-pass signal, statement and proof, PAM, Channel Bandwidth for a PAM signal, natural sampling, flat-top sampling, signal recovery through holding, quantization of signals, quantization error, PCM, electrical representations of binary digits, PCM systems, DPCM, delta Modulation, Adaptive delta modulation.

MODULE -V	**8 Hours**

Digital Modulation:

Introduction, Binary Shift Keying, DPSK, QPSK transmitter and receiver, signal-space representation, BFSK, spectrum, receiver for BFSK, TDM. Application of analog/digital communication in Instrumentation and Automation. Introduction to concept of FDMA, TDMA, CDMA

Simulation Experiments for AAT

AM modulator and Demodulator, DSB-SC modulator and Demodulator, FM modulator and Demodulator, PAM modulator and Demodulator, TDM Multiplexer and DE multiplexer.	
Text books:	
1.	"Analog and Digital communication ",Simon Haykin, John Willey.
2.	"Principles of communication systems",Taub and Schilling, Tata McGrawHill.
Reference books:	
1.	"Electronic Communication Systems", 2nd Edition,Blake, Thomson publishers.
2.	"Electronic Communication Systems",George Kennedy.
3.	"Process Control: Instrument Engineers' Handbook ", Béla G. Lipták
4.	"Communication Systems" 2nd Edition, R. P. Singh, S. D. Sapre, Tata McGraw-Hill Education
E-References	
1.	https://www.wiley.com/enus/An+Introduction+to+Analog+and+Digital+Communications%2C+2nd+Edition-p-9780471432227
2.	https://archive.org/details/PrinciplesOfCommunicationSystemsByTaubAndSchilling/page/n15/mode/2up
e–Learning :	
1.	http://nptel.ac.in/courses/117102059/
2.	http://nptel.ac.in/courses/117101051/
Internal choice: MODULE – I & V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand the concept of analog and digital communication system.	
CO2: Apply the concept of modulation and demodulation in AM & FM system.	
CO3: Analyse the various parameters in analog and digital communication system.	
CO4: Design the different digital modulation and demodulation systems.	
CO5: Simulate the modulator and demodulator for the given analog /digital communication system using modern tools.	

Course Title	**DIGITAL SIGNAL PROCESSING**				
Course Code	**22ES5PCDSP**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Signals and systems. Fourier series, Fourier transform					

MODULE-I	**8 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**
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	**8 Hours**
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**
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**
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.	
LAB Experiments: Generation of elementary signals, Study of sampling theorem, effect of under sampling leading to Aliasing effect, Study of properties of Linear time-invariant systems, Linear and Circular Convolution, Correlation ,Study of Discrete Fourier Transform (DFT) and its inverse. Study of Transform domain properties and its use, Study of Infinite Impulse Response (IIR) filter, Study of FIR filter design using window method: Low-pass and high-pass filter, Study of Adaptive filter using LMS Algorithm. Interpolation and Decimation.	

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
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: Understand signal properties, sampling theorem and represent Analog signals in Digital form	
CO2: Apply the analytical tools such as Discrete Fourier Transform and Fast Fourier Transform to obtain frequency domain representation of digital signals	
CO3: Analyse and obtain the Power Spectral Density of digital signals to arrive at specifications for digital filters	

CO4: Design IIR and FIR filters for linear filtering and use simulation tools to demonstrate convolution in frequency domain
CO5: Use modern tools to Design and write software modules for digital filters and digital signal processing techniques/operations
CO6: Investigate and conduct experiments to appreciate requirement of multi rate digital signal processing and adaptive filtering in digital signal processing applications.

Course Title	**PROCESS CONTROL SYSTEMS**				
Course Code	**22EI5PCPCS**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks(50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: 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	**TRANSDUCER AND INSTRUMENTAION**				
Course Code	**22EI5PCTNI**	**Credits**	**3**	**L-T-P**	**2:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Sensors and Measurement					
MODULE-I					**5 Hours**
Introduction to Sensor based Measurement System General concepts and terminologies, IO Configuration, Classification, Materials for sensors, Applications of Sensors.					
MODULE-II					**5 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	**5 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.

MODULE-IV	**5 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, Dead weight tester.

MODULE-V	**5 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. Simulate the performance of Biosensor& to simulate Biopotential Amplifier

8. Flow Through Pipes

9. Flow measurement by orificemeter and venturimeter

i) To find the coefficient of discharge for venturi meter.

ii) To find the coefficient of discharge for orifice meter.

10. Simulate the performance of chemical sensor (PH)

Text books:

1.	Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
2.	Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
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.

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.
2.	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/ 3.
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	**AIRCRAFT INSTRUMENTATION**				
Course Code	**22EI5PE1AI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Measurements and Instrumentation, Sensors and Transducers, Control Systems					
MODULE-I					**8 Hours**
Introduction: History of aircraft instrumentation, Basic principles of aircraft instrumentation Types of aircraft instruments, Displays and readouts, **Aircraft Systems and Architecture:** Airframe Systems, Vehicle Systems, Avionics Systems, Mission Systems, Ground Systems. Generic System, Systems Interaction, Examples of a Developing Architecture					
MODULE-II					**8 Hours**
Flight Control Systems: Principles of Flight Control, Primary Flight Control, Secondary Flight Control **Electrical Systems:** Evolution, Aircraft Electrical System, Power Generation and Distribution, Electrical Loads, Power Conversion and Energy Storage, Recent Electrical System Developments- Airbus A380, Boeing 787. **Flight Instruments:** Airspeed indicator, Altimeter, Attitude indicator, Heading indicator, Vertical speed indicator, Turn coordinator, Machmeter Electronic flight instrument system (EFIS), Principles of operation of flight instruments, Maintenance and troubleshooting of flight instruments					
MODULE-III					**8 Hours**
Navigation instruments: Magnetic compass, Gyrocompass, Attitude indicator, Directional gyro, VOR, ILS, GPS					
MODULE-IV					**8 Hours**

Engine Instruments: Tachometer, Engine temperature gauge, Engine pressure gauge, Fuel gauge, Oil pressure gauge, Oil temperature gauge, Principles of operation of engine instruments Maintenance and troubleshooting of engine instruments	
MODULE-V	**8 Hours**
Electronic Display Technologies: Situational awareness, Synthetic vision technology, Enhanced vision systems, Head-up-display, Combined vision system, Night-vision imaging systems **Troubleshooting and Maintenance of Aircraft Instruments:** Troubleshooting methods, Maintenance procedures, Case studies of aircraft instrument failures.	
Text books:	
1.	David Wyatt - Aircraft Flight Instruments and Guidance Systems_ Principles, Operations and Maintenance-Routledge (2015)
2.	Ian Moir, Allan Seabridge Aircraft systems_ mechanical, electrical, and avionics subsystems integration-2008
Reference books:	
1.	Michael H. Tooley - Aircraft digital electronic and computer systems (2022)
2.	Seabridge, Allan G - Design and development of aircraft systems-Wiley (2020)
3.	Instruments_Flying_Handbook
4.	Binns, Chris - Aircraft systems_ instruments, communications, navigation, and control-John Wiley & Sons (2019)
E-References	
1.	https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/phak/10_phak_ch8.pdf
2.	https://www.aircraftsystemstech.com/2019/01/aircraft-instrument-systems-maintenance.html
e–Learning :	
1.	https://www.grc.nasa.gov/www/k-12/airplane/
2.	https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap1_section_1.html
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 complex system in terms of Aircraft System Architecture and integration of subsystems	
CO2: Identify the different types of aircraft instruments and their operation	
CO3: Analyze the performance of aircraft instruments in functionality of Aircraft System	

CO4: Present case studies on troubleshooting and maintenance reports of aircraft instruments.

Course Title	**INDUSTRIAL PROCESS INSTRUMENTATION**				
Course Code	**22EI5PE1PI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: 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	**22EI5PE1SE**	**Credits**	**3**	**L-T-P**	**3:0:0**

CIE	100 Marks (50% weightage)	SEE	100 Marks(50% weightage)

Prerequisites: Mathematics, 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, future 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
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	**22EI5PE1CD**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: 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=o

	nepage&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 -I**				
Course Code	**22EI5PWMP1**	**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	**ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY**				
Course Code	**22EI5AEMI**	**Credits**	**1**	**L-T-P**	**0:1:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Engineering Mathematics, Engineering Physics, Basic Electrical, Basic Electronics, Analog Microelectronics and Instrumentation.					
MODULE-I					**3 Hours**
Introduction: Introduction to EMI, Definition of EMI/EMC, Electromagnetic environment, Electrical Noise Sources.					
MODULE-II					**3 Hours**
Electromagnetic Interference: EMI, Sources, Effects of EMI, Methods to eliminate EMI, Biological effects of EMI/EMR.					
MODULE-III					**3 Hours**
Electromagnetic Compatibility: Introduction EMC, EMC Standards, Advantages of EMC standards, Commercial and Military Standards on EMC.					
MODULE-IV					**3 Hours**
Grounding Technique and Filtering: Types of Grounds, Function of a Ground, Grounds Separation and Isolation, Single-Point, Multi-Point and Hybrid Grounds					
MODULE-V					**3 Hours**
EMC/EMI Modelling Techniques and Applications: Ansys EMC in analyzing lightning-induced electromagnetic (EM) effects on large platforms as well as cable EMI/EMC problems automobile and Instrumentation platforms.					
Text books:					

1.	L. Ashok Kumar, Y. Uma Maheswari, Electromagnetic Interference and Electromagnetic Compatibility, 1st Edition, CRC Press, 2023.
2.	Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons, 2009
Reference books:	
1.	Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', Prentice-Hall of India , Private Limited, New Delhi, 2006.
2.	Dr. V.P. Kodali, Engineering Electromagnetic Compatibility, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
E-References	
1.	https://www.ansys.com/en-in/applications/emi-emc
2.	https://www.routledge.com/Electromagnetic-Interference-and-Electromagnetic-Compatibility-Principles/Kumar-Y/p/book/9781032419763
e–Learning :	
1.	https://nptel.ac.in/courses/108106138
2.	https://archive.nptel.ac.in/courses/108/106/108106138/
Internal choice: MODULE NA	
Course outcomes At the end of the course ,the student will have the ability to	
CO1: Understand the basics of EMI & EMC.	
CO2: Carry out the impact analysis of Electro Magnetic Interference and Electro Magnetic Compatibility in the context of engineering solutions and environmental sustainability.	

Course Title	**PROJECT MANAGEMENT AND FINANCE**				
Course Code	**22ES5HSPMF**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Personality development course, soft skills					
MODULE-I					**5 Hours**
Concepts of Project Management - Concepts of project, Categories of project, Project life cycle 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 breakdown 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	
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

Course Title	**TECHNICAL WRITING**				
Course Code	**22EI5NCTWR**	**Credits**	**-**	**L-T-P**	**-**

At the end of this course, students will be able to:

● Demonstrate rhetorical knowledge to create effective technical writing documents for end users.

● Apply and adapt flexible writing process strategies to produce clear, high-quality deliverables in a multitude of technical writing genres.

● Use professional technical writing conventions of clean and clear design, style, and layout of written materials.

● Gather and apply researched information that is appropriate to your field, as demonstrated by reading and analysing documents, and citing sources correctly.

● Write clearly, correctly, and concisely.

The Assessment includes

Writing a Technical Description • What is a technical description? • What purpose do they serve? • Who are they serving? Internal Communication: Writing Memos and Emails, Ethics of Electronic Communication Internal Communication: Writing Memos and Emails External Communication: Formal Letters Instruction Manual: Getting Started • What is an Instruction Manual? • Writing an Instruction Manual Outline Using Visuals to Convey Information Process Documentation, Process Documentation External Communication: Formal Letters, Using Visuals to Convey Information, Using Existing Images: Understanding Copyright, Ethics, Data Presentation

VI Semester

Course Title	PROCESS AUTOMATION				
Course Code	22EI6PCPSA	Credits	4	L-T-P	3:0:1
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: 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, Processor memory organization, Program scan, Programming standards of PLC. Industrial Networks of PLCs: Star, Ring, Bus topology

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, Sealing in Circuits, Latching Relays, Related programming and practice examples, Programming timers - Applications.

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

MODULE-III	8 Hours

Control and Data Manipulation Instructions : Master Control Reset instruction

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, and Integration: OPC, Profibus and Foundation Field Bus, Serial Communication.

MODULE-V	8 Hours

HMI in Automation:

Introduction to HMI, Architecture Of HMI, Human Interface subsystem, Operator Panel, Construction of the panel, Interfacing with control subsystem, Types of mimic panels, Advance Human Interface System, Intelligent Operator Panel, Operator Station, and Data logging Station.

SCADA

Introduction, Brief history of SCADA, elements of SCADA. Client/Server architecture, Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Protocol Detail SCADA as a real time system Communications in SCADA- types; communications SCADA Development for any one typical application Programming for GUI development using SCADA software.

Text books:

1.	"Programmable Logic Controllers, fourth edition", Frank D. Petruzella, McGraw Hill, India, 2016.
2.	"Industrial Process Automation Systems- Design and Implementation", B.R. Mehta Y. Jaganmohan Reddy, 1st Edition, Elsevier, 2014

Reference books:

1.	"Programmable Logic Controllers – Principles and Applications", John W. Webb & Ronald A Reis, 5th edition, Pearson, 2015
2.	"Advanced Industrial Automation: PLC programming in simplest way with 110 solved examples", Himanshu Kumar, Notion Press, 2020.
3.	"Introduction to Industrial Automation", Stamatios Manesis, George Nikolakopoulos, CRC Press
4.	"Practical SCADA for Industry", David Bailey, Edwin Wright Newnes, an imprint of Elsevier, 2003.
5.	"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/#

Internal choice: MODULE – II & V

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: Analyze and develop appropriate algorithms to design automation solutions.
CO3: Investigate the requirement of PLC, DCS, SCADA in various scenarios.
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	**EMBEDDED SYSTEM DESIGN**				
Course Code	**22EI6PCESD**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: ARM Processor, 'C' Programming, Sensors and Measurements, Control System					
MODULE-I					**8 Hours**
Fundamentals of Embedded System: Real time system's requirements, real time issues, interrupt latency. Characteristics and quality attributes (Design Metric) 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, Concept of RTOS, Drivers, Application programs, Power-supply (Battery technology, Solar), Safety and reliability, environmental issues. Ethical practice. Embedded Product development life cycle					
MODULE-II					**8 Hours**
Basic embedded C Applications: Embedded C-programming concepts (from embedded system point of view): data types, modifiers Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, 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, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee	
MODULE-V	**8 Hours**
Embedded Software, Firmware Concepts and Design: 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 MODULE – 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	INDUSTRIAL DATA NETWORKS				
Course Code	22EI6PCIDN	Credits	2	L-T-P	2:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Communication Systems,

MODULE-I	5 Hours

Introduction, Open System Interconnection model of ISO, Data link control protocol: HDLC, Media access protocol, CSMA/CD, TCP/IP.

MODULE-II	5Hours

Inter Networking

Bridges, Routers, Gateways, Standard ETHERNET,10Mbps Ethernet, 100Mbps Ethernet, and ARCNET, RS 232 and RS 485.

MODULE-III	5 Hours

Hart Protcol

Introduction, Evolution of signal standard, HART communication protocol, Communication modes, HART networks, HART commands, HART applications.

MODULE-IV	5 Hours

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-V	5Hours

Modbus And Profibus

MODBUS protocol structure, function codes, troubleshooting, Profibus: Introduction, profibus protocol stack, profibus communication model communication objects, system operation, troubleshooting, review of foundation field bus.

Text books:

1.	Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, 'Practical Industrial Data networks Design, Installation and Troubleshooting', Newnes publication, Elsevier First edition, 2004.
2.	Lawrence M. Thompson, Tim Shaw, 'Industrial Data Communications', ISA, 5th Edition, 2015.

Reference books:

1.	Larry L. Peterson, Bruce S. Davie, Computer Networks A Systems Approach, Elsevier, 2021 Edition.
2.	Jason Edelman, Matt Oswalt, Scott Lowe, Network Programmability and Automation, Shroff/O'Reilly, First Edition, 20 February 2018.
E-References	
1.	https://www.elsevier.com/books/practical-industrial-data-networks/mackay/978-0-7506-5807-2
2.	https://www.elsevier.com/books/computer-busses/buchanan/978-0-340-74076-7
e–Learning :	
1.	https://digimat.in/nptel/courses/video/106105082/
2.	https://digimat.in/nptel/courses/video/106105183/
Internal choice: MODULE – I & IV	
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.	

Course Title	**LASER AND OPTICAL INSTRUMENTATION**				
Course Code	**22EI6PCLOI**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Physics, Communication Systems and Sensors and Measurement.					
MODULE-I					**5 Hours**
Fundamentals of Laser, Types and Characteristics: Laser characteristics, population inversion, construction of Ruby, He-Ne, Nd-YAG, Semiconductor, and Carbon dioxide lasers. Characteristics of stabilization, Q-switching and mode locking.					
MODULE -II					**5 Hours**
Laser Instrumentation: Measurement of distance - Interferometric methods, beam modulation telemetry, pulse echo techniques. Laser Doppler velocimetry- Holography-principle, laser welding, laser machining.					
MODULE -III					**5 Hours**
Optical Fibers And Their Properties: Introduction to Optical Fibers - principles of light					

propagation through a fiber – Different types of fibers and their properties –Transmission characteristics of optical fiber –Absorption losses – Scattering losses – Dispersion. Intermodal dispersion, graded index fiber, low dispersive fiber losses.	
MODULE -IV	**5 Hours**
Optical Fiber Sensors: Multimode passive and active fiber sensors, phase modulated sensors, current measurement by single-mode optical fiber sensors, fluro-optic temperature sensors, photo elastic pressure sensors, polarization fiber sensors.	
MODULE -V	**5 Hours**
Optical Fiber Instrumentation: Fiber optic Instrumentation system - Interferometric method of measurement of length - Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain. Fiber optic Gyroscope, Fiber Bragg Gratings principle.	
Text books:	
1.	"Optoelectronics", Wilson & Hawkes, Prentice Hall of India.
2.	Optoelectronics and Fiber Optics Communication – C.K.Sarkar and D.C. Sarkar, New Age Int. Pub., 2004
3.	"Laser principles and applications", Wilson and Hawkes, Prentice Hall of India
Reference books:	
1.	John and Harry, Industrial Lasers and their Applications, McGraw Hill, 1974.
2.	Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985.
3.	Keiser G., Optical Fiber Communication, McGraw Hill, 1991
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.	http://gsundar.weebly.com/uploads/5/4/5/6/54560163/optical_fiber_communication_by_gerd_keiser.pdf
e–Learning :	
1.	https://nptel.ac.in/courses/117/101/117101002/
2.	https://nptel.ac.in/courses/115/107/115107122/
3.	https://nptel.ac.in/courses/108/104/108104113/
Internal choice: MODULE – I & III	
Course outcomes	

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	**BIOMEDICAL INSTRUMENTAION**				
Course Code	**22EI6PE2BI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: 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:

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

Reference books:

1.	John G. Webster, ―Medical Instrumentation Application and Design‖, John Wiley and sons, New York, 2009
2.	Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, UK,2003
3.	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	**INTERNET OF THINGS AND INDUSTRIAL IOT**				
Course Code	**22EI6PE2IT**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: General Concepts of Sensors, Computer and Internet, Basic Programming					
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	**22EI6PE2DP**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Digital Electronics, 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	**22EI6PE2AM**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% Weightage)**		
Prerequisites: 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 forneural network learning, Perceptrons, Multilayer networks and Backpropagation 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

Course Title	**SMART SENSORS**				
Course Code	**22EI6OE1SS**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Process Control, Basic Programming					
MODULE-I					**8 Hours**
Smart Sensors basics: General sensing system, mechanic to electronic transitions in sensing, nature of sensors, smart sensor model, Integration of Micromachining and Microelectronics. **Micromachining:** Bulk micromachining, wafer bonding, Surface micromachining, LIGA process, dry-etching process, lasers in micromachining.					
MODULE-II					**8 Hours**
Sensors information into MCU and increasing sensor IQ:					

Amplification and signal conditioning, sleep mode operational amplifier, 4 to 20mA signal transmitter, MCUs for control, sensor interface, DSP controls	
MODULE-III	**8 Hours**
Communications for smart sensors: Sources (Organizations) and Standards, automotive protocols, Industrial Networks-LonTalk™ Protocol, HART, Profibus, Office/Building Automation, Home Automation, Other Aspects of Network Communications **Transceivers, Transponders, and Telemetry:** The RF Spectrum**,** Spread Spectrum, Wireless Data and Communications, RF Sensing, telemetry and RF MEMS	
MODULE-IV	**8 Hours**
Smart sensing Standards: Need of setting standards for smarty sensors and systmes-IEEE1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4 network communication models, network capable application processor, and technical electronic data sheet. **Implications of smart sensor standards:** Sensor plug and play, Ethernet, sensing by Modem, automated/ remote sensing, wireless protocol, remote diagnosis, process control over internet.	
MODULE-V	**8 Hours**
Packaging of smart Sensors: Semiconductor Packaging Applied to Sensor, Hybrid Packaging, Packaging for Monolithic Sensors. **The Next Phase of Sensing Systems:** Future Semiconductor Capabilities, Future System Requirements, Not-So-Futuristic Systems, Alternative Views of Smart Sensing, the Smart Loop	
Case studies: 1. Smart sensors and systems for medical applications 2. Smart sensors and systems for environmental applications 3. Smart sensors and systems for IoT applications	
Text books:	
1.	"Understanding Smart Sensor", Randy Frank,Second edition, Artech House, Boston • London,2000
2.	"Smart sensors systems". Gerard Meijer, John Wiley & Sons Inc, 2008
Reference books:	
1.	"Smart sensors and systems" Technology and Engineering, Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu, Youn-Long Lin, Springer, 2017.
2.	"Implantable Sensors and Systems- from theory tp practice", Guang-Zhong Yang, Springer, 2018.
3.	"Smart Sensors for Health and Environment Monitoring" Chong-Min Kyung, Springer, 2015.
e–Learning :	

1.	https://nptel.ac.in/courses/108106193
2.	https://onlinecourses.nptel.ac.in/noc23_ee109/preview
3.	https://onlinecourses.nptel.ac.in/noc23_ee95/preview

Internal choice: MODULE – III & IV

Course outcomes

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

CO1: understand the basics of smart sensing technology, its fabrication and packaging.

CO2: identify various communication protocol to a given smart sensing applications

CO3: apply smart sensing standards and its implications for smart sensing applications

CO4: Engage in independent study and communicate effectively through presentations and reports.

Course Title	**SENSOR AND INSTRUMENTATION**				
Course Code	**22EI6OE1SI**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Process Control, Basic Programming

MODULE-I — **8 Hours**

Sensors & Transducer:

Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

MODULE-II — **8 Hours**

Measurement of temperature: Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor

Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive

MODULE-III — **8 Hours**

Virtual Instrumentation:

Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

MODULE-IV — **8 Hours**

Data Acquisition Methods:

Basic block diagram, Analog and Digital I/O, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.	
MODULE-V	**8 Hours**
Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.	
Text books:	
1.	DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2.	D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
Reference books:	
1.	Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2.	A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001.
3.	Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition 2012, Oxford University Press.
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc23_ee105/preview
2.	https://www.udemy.com/topic/labview/
3.	http://www.digimat.in/nptel/courses/video/117108038/L38.html
Internal choice: MODULE – III & IV	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Apply the use of sensors for measurement of displacement, force and pressure.	
CO2: Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.	
CO3: Demonstrate the use of virtual instrumentation in automation industries	
CO4: Identify and use data acquisition methods	
CO5: Comprehend intelligent instrumentation in industrial automation.	

Course Title	**MINI PROJECT -II**				
Course Code	**22EI6PWMP2**	**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	**Internship Based Seminar**				
Course Code	**22EI6SRIN2**	**Credits**	**01**	**L-T-P**	**0:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VIII semesters. The internships can be taken up in an industry, government organization, a research organization or an academic institution, either in the country or outside the country, that include

activities like:

1 Successful completion of Value Added Programs/Training Programs/workshops organized by academic Institutions and Industries

2 Soft skill training by the Placement Cell of the college

3 Active association with incubation/ innovation /entrepreneurship cell of institute

4 Participation in Inter-Institute innovation related competitions like Hackathons

5 Working for consultancy/ research project within the institutes

6 Participation in activities of Institute"s Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests

7 Internship with industry/ NGO"s/ Government organizations/Micro/Small/Medium enterprises

8 Development of a new product/ business plan/ registration of a startup Long term rural internship For complete details refer: AICTE Internship Policy: Guidelines and Procedure

E-References

1.	http://nptel.iitm.ac.in

e–Learning :

1.	https://nptel.ac.in/courses/108/105/108105062/#

Course outcomes

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

CO1: Conduct a literature review, present and prepare the report.

CO2: Engage in internship in an engineering domain and comprehend the professional norms of the organization.

CO3: Interpret technological solutions, keeping the standard practices and scalability in to consideration.

CO4: Work as an individual towards critical thinking about topics of current trends in chosen technical domain.

Course Title	**INDUSTRIAL SAFETY AND STANDARDS**				
Course Code	**22EI6HSISS**	**Credits**	**1**	**L-T-P**	**1:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: General concepts of Industry environment

MODULE-I	**3 hours**

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	**3 hours**

Building Construction : Introduction, Classification of building in the country, various types of occupancies and firefighting techniques, Importance's of fire escapes with respect to their

positioning, Reference to NBC part II fire construction and provisioning of firefighting 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	**3 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

MODULE-IV	**3 hours**

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

MODULE-V	**3 hours**

IEC Standards Overview : 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

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 fundamentals of Industrial Safety and Standards

CO2: Identify and select appropriate extinguishers and categorize electrical hazard and risk and its mitigation.

CO3: Select and categorize electrical hazard and risk and its mitigation.

Course Title	Personality Development and Communication				
Course Code	22EI6NCPDC	Credits	-	L-T-P	-

This activity provides an opportunity for students to develop Aptitude and Soft skills which will be helpful during Placements.

Students regularly attend Skill development training and placement classes conducted by Placement department.

Students has to learn sentence correction, error spotting, idioms and phrases, sentence completion and analogies, time and work, time, speed and distance, coding, decoding, number series and letter series, permutation and combination, probability and mensuration and partnership.

At the end of the course students has to take the quiz conducted by placement department and get minimum marks to clear the course.

VII Semester

Course Title	BIOLOGY FOR ENGINEERS (Common for EEE, ECE, ETE, EIE)				
Course Code	22ES7BSBFE	Credits	1	L-T-P	1:0:0
CIE	100 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basic Biology

MODULE-I	3 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.

MODULE-II	3 Hours

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).

MODULE-III	3 Hours

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.

MODULE-IV	3 Hours

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.

MODULE-V	3 Hours

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	**VLSI DESIGN**				
Course Code	**22EI7PCVLI**	**Credits**	**4**	**L-T-P**	**3:0:1**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
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	**AUTOMOTIVE ELECTRONICS**				
Course Code	**22EI7PE3AE**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Automotive Electrical Systems, Ignition Magneto, Spark-Ignition Engine, Petrol Engine.					
MODULE-I					**8 Hours**
Automotive Fundamentals Overview: Evolution of Automotive Electronics, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of Engine performance terms, Effect of Air/Fuel ratio, spark timing and EGR on performance, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.					
MODULE-II					**8 Hours**
Automotive Sensors and Actuators: Typical Electronic Engine Control System, Variables to be measured Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor , Engine Coolant Temperature Sensor, Exhaust Gas Oxygen, Lambda					

Sensors, Piezoelectric Knock Sensor. Automotive Actuators :Solenoid, Fuel Injector, EGR Actuator, Ignition System.	
MODULE-III	**8 Hours**
Digital Engine Control Systems : Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. Control units, Operating conditions, design, data processing, digital modules in the control units, control unit software.	
MODULE-IV	**8 Hours**
Automotive Diagnostics: Timing Light, Engine Analyzer, On-board diagnostics, Offboard diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer based Air Bag systems. **Future Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display, Speech Synthesis, Navigation – Navigation Sensors - Radio Navigation, dead reckoning navigation, Voice Recognition Cell Phone dialling, Advanced Cruise Control, Automatic driving Control.	
MODULE-V	**8 Hours**
Automotive Networking : Bus Systems – Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces. **Vehicle Motion Control :** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics , Antilock Brake System	
Unit Choice: I and IV	
Textbooks:	
1.	William B.Ribbens, “Understanding Automotive Electronics”, 6th Edition, Elsevier Publishing.
2.	Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc.2007

Reference books:	
1.	Understanding Automobile electronics, William B Ribbon, 6th Edition, 2003 Elsevier Science.
2.	Automotive Electronics Handbook 2nd Edition by Ronald K. Jurgen
E-References	
1.	https://www.pdfdrive.com/ Automotive Electronics Handbook 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 the knowledge of engineering and science to analyse the performance of Electronic Engine Control, working of sensors and actuators.	
CO2: Analyze the vehicle level Electronic Control for automotive subsystems.	
CO3: Gain insight about building future automotive subsystems that contributes to the safety and health of the society using block diagram approach..	

Course Title	**COMPUTER VISION**				
Course Code	**22EI7PE3CV**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Digital Signal Processing, Digital Image Processing					
MODULE-I					**8 Hours**
Digital Image Formation and processing Overview and State-of-the-art techniques for Image Processing, Fundamentals of Image Formation, Transformation, Working of Pinhole camera, Colored image, Gray, Binary, Indexing of image, Image Enhancement, Geometric Transformation- Orthogonal, Euclidean, Affine, Projective, Noise, Convolution, Thresholding techniques					
MODULE-II					**8 Hours**
Feature Extraction Filtering; Laplacian of Gaussian, Derivative of Gaussian and Edge Detection, Prewitt's, Sobel Edge Detector, Orientation of Edge- Canny Detector; Line detectors (Hough Transform), Corners - Harris and Hessian, Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis-Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT					

MODULE-III	**8 Hours**
Image Segmentation and Object Detection **Image Segmentation:** Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection. **Object Detection:** Binary shape analysis, connectedness, object labelling and counting; Boundary tracking procedures, active contours; Boundary descriptors, chain codes, Fourier descriptors, region descriptors, moments	
MODULE-IV	**8 Hours**
Motion Analysis Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.	
MODULE-V.	**8 Hours**
Applications and Modern Trends CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models.	
Textbooks:	
1.	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2.	E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
Reference books:	
1.	Gonzalez, R. C. and Woods, R. E., "Digital Image Processing"
2.	Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision
E-References	
1.	https://github.com/sunitadhavale/computervision
2.	https://www.coursera.org/courses?query=computer%20vision
e–Learning :	
1.	https://onlinecourses.nptel.ac.in/noc19_cs58/preview
2.	https://archive.nptel.ac.in/courses/108/106/108106189/
Internal choice: MODULE – Ⅱ & Ⅲ	
Course outcomes At the end of the course, the student will have the ability to	

CO1: Apply the principles of general practices followed in image formation for generating denoised images.
CO2: Analyse feature extraction technique applicable to images to provide solutions.
CO3: Model and build prototypes of the motion dynamics using the modelling techniques
CO4: Implement algorithms image processing techniques for computational photography and present the solution.

Course Title	**ROBOTICS AND AUTOMATION**				
Course Code	**22EI7PE3RA**	**Credits**	**03**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Control Systems, Sensors and Measurement Techniques					
MODULE-I					**8 Hours**
Introduction to Robotics Types and components of a robot, Classification of robots, Kinematics systems; Definition of mechanisms and manipulators, Degrees of Freedom					
MODULE-II					**8 Hours**
Robot Kinematics and Dynamics Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Singularity, and Statics, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation					
MODULE-III					**8 Hours**
Sensors in Robotics Sensor: Contact and Proximity, Position, Velocity, Force, Tactile, etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.					
MODULE-IV					**8 Hours**
Robotic Actuation Systems Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.					
MODULE-V.					**8 Hours**
Embedded Systems in Robotics Microcontroller Architecture and integration with sensors, actuators, components, Programming Applications for Industrial robot - programming in – VAL II					

Textbooks:	
1.	Introduction to Robotics: J. Craig , Pearson
2.	Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
Reference books:	
1.	Robotics Engineering: R. Klafter, PHI
2.	Robotics: Subir K Saha , Mc GrawHill
E-References	
1.	https://www.edx.org/learn/robotics
2.	https://www.coursera.org/courses?query=robotics
e–Learning :	
1.	https://academy.universal-robots.com/free-e-learning/
2.	https://new.abb.com/products/robotics/service/training/online-learnings
Internal choice: **MODULE – Ⅱ & Ⅲ**	
Course outcomes at the end of the course, the student will have the ability to	
CO1: Apply kinematic and dynamic analyses with simulation.	
CO2: Design control laws for a simple robot.	
CO3: Integrate mechanical and electrical hardware for a real prototype of robotic device.	
CO4: Select a robotic system for given industrial application.	

Course Title	**MULTI DOMAIN SYSTEM MODELLING**				
Course Code	**22EI7PE3MD**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Control System, Numerical Techniques					
MODULE-I					**8 Hours**
Introduction to Cyber Physical Systems and multi-domain modelling Mathematical modelling of dynamical systems. Mathematical models. First-order linear ODE models. General first-order ODE models. Higher-order ODE models. Laplace transforms. Multivariable ODE models. Symbolic, graphical and numerical computation. Review of the main elements of mathematical modelling for dynamical systems with lumped parameters.					
MODULE-II					**8 Hours**

Introduction to Differential Algebraic Equations

Installation and basic usage of the scientific computing tools, SCILAB and OpenModelica.

Numerical Simulation of dynamical systems: Introduction to numerical methods. Basic usage of Scilab. Numerical ODE solving. ODE solving with Scilab. Solving ODE systems with Scilab. Numerical simulation with Xcos.

MODULE-III	**8 Hours**

Modelling and simulation of multi-domain systems with Modelica

Basic elements of the Modelica language. Physical modelling and simulation with OpenModelica. Simulation of mechanical oscillators with OpenModelica. Simulation of Electrical systems.

MODULE-IV	**8 Hours**

Application of Open Modelica Libraries

Blocks, Basic input/output control blocks (continuous, discrete, logical, table blocks), Complex Blocks, Basic input/output control blocks with Complex signals, Electrical, Magnetic and Mechanics Libraries.

MODULE-V	**8 Hours**

Application of Modelica in System building

Modelling of Mechanical Vibrations and System in Automotive applications, Modelica in Avionics, Modelica in Biomechanics.

Textbooks

1.	Campbell, S. L.; Chancelier, J. P.; Nikoukhah, R. Modeling and simulation in Scilab/Scicos [online]. New York: Springer, 2006 [Consultation: 23/01/2019].
2	Modelica by Example, Release v0.6.0, Michael Tiller, 2019

References:

1.	Principles of Object-Oriented Modeling and Simulation with Modelica 3.3: A Cyber-Physical Approach, Peter Fritzson 2015.
2	Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica. Peter Fritzson., 2011

E-References	
1	http://dx.doi.org/10.1007/0-387-30486-X. ISBN 9780387278025.
2	http://eu.wiley.com/WileyCDA/WileyTitle/productCd111801068X.html

Internal choice: MODULE – I & IV

Course outcomes: At the end of the course, the student will be able to

CO1: Formulate suitable mathematical models for different types of dynamical systems.

CO2: Apply the open-source computer tools Scilab to model and simulate dynamic systems of special relevance in engineering.

CO3: Use the Modelica simulation language, in particular its open-source implementation OpenModelica, to model and simulate complex and multi-domain physical systems

Course Title	**Project -3**				
Course Code	**22EI7PWPW3**	**Credits**	**-**	**L-T-P**	**0:0:3**
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.
- The prototype building 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	**INSTRUMENTATION FOR BUILDING AUTOMATION**				
Course Code	**22EI7OE2BA**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

MODULE-I	**8 Hours**

Automation System Structure:

Introduction, Needs and benefits of automation, Subsystems, Input Instrumentation Subsystem, Output Instrumentation Subsystem, Human Interface Subsystem- Direct Monitoring, Direct Control, Control Subsystem- Data Acquisition, Data Analysis and Decision Making, Control Execution, Communication. Basic strategies, Open and closed loop, Discrete, Continuous and Hybrid

MODULE-II	**8 Hours**

Building Automation System (BAS)

Introduction, Progress of BAS- Evolution, Programming and monitoring platforms and environment, Building management functions, Difference Between Building Automation and Building Control, Benefits, Structure of Building Automation and Control Networks, Typical architecture of Building Automation Systems (BAS)

Basic Functions of Building Automation: Basic Function Reporting, Basic Function Metering, Basic Function Measuring, Basic Function Switching, Basic Function Setting, System Information Schema.

MODULE-III	**8 Hours**

Sensors and Actuators:

Role of Sensors and Actuators- Importance of Estimation in Sensing, Innovative Sensor Technologies. Application Scenarios. Analog and Digital Sensors- Selection and its Applications, Digital and Innovative Sensing: Innovative Sensor Technologies, Continuous-Drive Actuators: Requirements and Applications, Overview of Temperature sensors and thermal actuators, Optical sensors and actuators, Electric and magnetic sensors and actuators, Mechanical sensors and actuators, Acoustic sensors and actuators, Chemical and biological sensors and actuators, Radiation, MEMS and smart sensors

MODULE-IV	**8 Hours**

Basics of Industrial Communication Technology:

Industrial Communication, Digital Data Transfer: Important Terms and Definitions, ISO/OSI Reference Model, Field Bus and Network: Important Terms and Definitions

BAS communication standards and architecture:

Background and problems, BACnet and its features, Konnex and its features, LonWorks and its features, Modbus and its features, PROFIBUS and its features, EIB and its features, Compatibility of different open protocol standards, Integration at management level. Examples.

Internet technologies and their applications in BASs:

An overview of applications of Internet technologies in BAS, Use of Internet technologies at automation level, Use of Internet technologies at management level, Convergence networks and total integration.

MODULE-V	**8 Hours**

Smart Building: Introduction, What is Smart Building, Foundations of a Smart Building. Heating, Ventilating, and Air Conditioning Systems

Control and Optimization of Air-Conditioning Systems: Typical control loops of the air-conditioning process, Control of CAV systems, Control of VAV systems

Lighting-Control Systems: Purpose of lighting- control system, Basic components of lighting and lighting- control systems, Systems based on standard lighting- control protocols.

Security and Safety Control Systems: CCTV systems, Access- control systems, Burglar alarm systems, Fire alarm systems, System integration and convergence.

Textbooks:

1.	Hermann Merz, Thomas Hansemann, Christof Hübner - Building Automation-Springer International Publishing (2018)
2.	Shengwei Wang, Intelligent Buildings and Building Automation, Spon Press (2009)

Reference books:

1.	KLS Sharma, Overview of Industrial Process Automation, Second edition, Elsevier (2017)
2.	James M Sinopoli, Smart Buildings Systems for Architects, Owners and Builders, Elsevier Science & Technology (2010)
3.	John T. Wen, Sandipan Mishra -Intelligent Building Control Systems A Survey of Modern Building Control and Sensing Strategies, Springer Publications (2018)
4.	Nathan Ida- Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, The Institution of Engineering and Technology; 2nd edition (2020)

5.	Clarence W. de Silva, Sensors and Actuators Engineering System Instrumentation, Second Edition, CRC Press (2016)
E- References:	
1.	https://digital.library.ryerson.ca/islandora/object/RULA%3A6887/datastream/OBJ/view
2.	https://link.springer.com/book/10.1007/978-3-319-68462-8
3.	https://www.udemy.com/topic/building-management-system/ https://www.tpctraining.com/blogs/news/introduction-to-building-automation-systems-1
Internal choice: MODULE – IV & V	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Analyze the structure and functionalities of building automation systems (BAS)	
CO2: Identify the role of sensors and actuators in building automation, including application scenarios and innovative technologies	
CO3: Apply fundamental industrial communication technologies and open protocol standards for data exchange within Building Automation Systems	
CO4: Evaluate control strategies for air-conditioning and lighting systems in buildings, optimizing energy efficiency and occupant comfort	

Course Title	**PRODUCT DESIGN TECHNOLOGY**				
Course Code	**22EI7OE2PD**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: knowledge of 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:	
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	**INTELLECTUAL PROPERTY RIGHTS AND CYBER LAW (Common for EIE, EEE)**				
Course Code	**22ES7HSIPL**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
MODULE-I				**4 Hours**	
Basic principles of IP laws & Patents: Introduction, Concept of property, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, 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.					
MODULE-II				**6 Hours**	
Procedure for obtaining patent: Submission of application, filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license. **Provisional and complete specification:** Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment. Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee.					

Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.

MODULE-III	**6 Hours**

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies

Trademarks: 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.

MODULE-IV	**5 Hours**

Cyber Law: An introduction, Definition, why cyber law in India, Evolving cyber law practices- for corporates, privacy in Indian cyber space. Terrorism & Cyber Crime. Cyber theft and Indian telegraph act, Cyber Stalking,

MODULE-V	**4 Hours**

Indian Cyber law: Protecting Indian children online, POCSO act, Spam, contempt in cyber space, Indian consumers & cyber space, E-courts of India, Emerging trends in cyber law.

Textbooks:

1	Dr. T Ramakrishna, "Basic principles and acquisition of Intellectual Property Rights", CIPRA, NSLIU -2005.
2	Dr.B.L.Wadehhra,"Intellectual Property Law Handbook", Universal Law Publishing Co. Ltd., 2002.
3	Cyberlaw-The Indian perspective by Pavan Duggal, 2009 Edition.

Reference books:

1.	Dr.TRamakrishna,"Ownership and Enforcement of Intellectual Property Rights", CIPRA, NSLIU-2005.
2.	"Intellectual Property Law (Bare Act with short comments)", Universal Law Publishing Co. Ltd. 2007
3.	"The Trademarks Act 1999 (Bare Act with short comments)", Universal Law Publishing Co. Ltd., 2005.
E- References:	
1.	https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf
2.	http://osou.ac.in/eresources/introduction-to-indian-cyber-law.pdf
e–Learning :	
1.	https://nptel.ac.in/courses/110/105/110105139/
2.	https://nptel.ac.in/courses/109/106/109106137/
Internal choice: MODULE – II & III	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks.	
CO2: Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context	
CO3: Use IPRs and Cyber Law to access societal, health, safety & Cultural issues.	
CO4: Effectively work in multiple teams to communicate IP & Cyber Law.	

Course Title	**MOOCs Course -1**				
Course Code	**22EI7NCMC1**	**Credits**	**-**	**L-T-P**	**-**
Students need to have taken and successfully completed ONE MOOC course (of minimum four weeks duration), from any recognized online platform: NPTEL/SWAYAM/ Coursera/ Edx etc. The courses can be in the Engineering domain, Management domain, Science Domain, Sanskrit / Foreign Language, Art (music/dance/theatre any other), Journalism (media communication or any other), or any domain. Students are awarded a Pass Grade on submission of the successful completion certificate and needs to have taken the course any time after having joined the program.					

VIII Semester

Course Title	ANALYTICAL INSTRUMENTATION				
Course Code	22EI8PE4AN	Credits	3	L-T-P	3:0:0
CIE	50 Marks (50% weightage)	SEE	100 Marks (50% weightage)		

Prerequisites: Basic electronics, laser and optical instrumentation

MODULE-I	8 Hours

Introduction

Types of instrumental methods for analysis, electromagnetic spectrum, properties of electromagnetic radiation and its interaction with matter, emission of radiation.

Molecular spectroscopy: Measurement of transmittance and absorbance, Beer Lambert's law, instrumentation, single and double beam spectrometers, application of UV- Visible spectroscopy for qualitative and quantitative analysis. IR absorption spectrometry, IR instruments- dispersive and non-dispersive, application for quantitative analysis.

MODULE-II	8 Hours

Atomic absorption and emission spectroscopy

Principles, sample atomization techniques, atomic absorption instrumentation, interferences

In atomic spectroscopy, standard addition and internal standard methods of evaluation.

Principles, arc, spark and plasma sources, emission based on plasma sources, emission Spectroscopy based on arc and spark sources

MODULE-III	8 Hours

Analysis using electrical properties and x-ray spectroscopy

Electrical Conductivity analyze- Introduction and applications, Methods of measurement of conductance: - null method, - direct reading method, Conductivity cell - Temperature compensation in conductivity measurement, Principle of pH measurement, electrode for pH measurement, Electronics circuit for pH measurement, Calibration.

X-ray spectroscopy - Fundamentals, instrumentation, X-ray absorption methods, X-ray fluorescence methods, X-ray diffraction and its applications.

MODULE-IV	8 Hours

Mass spectroscopy

Features of mass spectroscopy, Basic mass spectrometer, types of mass spectrometer,

Components of mass spectrometer, ion sources, sample inlet systems, mass analyzers – single beam, double beam and quadruple instruments, applications.

MODULE-V	8 Hours

Chromatography

Classification of chromatographic Methods, Gas Chromatographs, Function Components of a Gas Chromatograph, Sample Handling System, Gas Chromatographic Columns, Liquid Phases and Column Selection, chromatogram-response factor, Detectors for Gas chromatography.

Liquid chromatography, basic concepts, types of liquid chromatography, HPLC, Principle and Instrumentation.

Textbooks:

1.	"Principles of Instrumental Analysis-6th Edition", Douglas A. Skoog, James Holler, Stanley R. Crounch. Thomson Learning
2.	"Instrumental Methods of Analysis", Willard H.W Merritt, L.L Dean J A Settie FA,7thEdition, CBSPublishers

Reference books:

1.	Khandpur. R.S, "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 2003.
2.	"Fundamentals of Analytical Chemistry", Douglas A Skoog, Donald M West Holler Thomson Learning
3.	"Instrumental Methods of Chemical Analysis", Galen W. Ewing, McGrawHill
4.	"Instrumental methods of analysis by H.H Willard, L.L. Meritt & A. Dean, CBS ublications 7th Edn., 1988
5.	Principles of Instrumental analysis by S.J. Holler & T. A. Nilman Saunders college publications, 5th Edn, 1998.

E-References

1.	https://nptel.ac.in/courses/103/108/103108124/
2.	https://nptel.ac.in/courses/103/108/103108100/

e-books

1.	https://www.amazon.com/Instrumental-Methods-Analysis-Willard/dp/8123909438
2.	https://www.amazon.com/Principles-Instrumental-Analysis-Douglas-Skoog/dp/0495012017

Internal choice Module– I and II

Course outcomes

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

CO1: Understand how electromagnetic radiations interact with matter and utilize analytical methods to precisely identify elements in a provided sample, along with related phenomena.

CO2: Utilize and evaluate fundamental engineering concepts in grasping the foundational instrumentation principles of different spectroscopic techniques.
CO3: Identify and comprehend the working of various transducers in various spectroscopic methods:
CO4: Ability to engage in effective written and Oral communication through the report/poster by taking a case study/literature paper review/ICT video of analytical instrument in the Industrial/environmental applications.

Course Title	**CYBER SECURITY**				
Course Code	**22EI8PE4CS**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Basics knowledge of Networking.					
MODULE-I					**8 Hours**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime, and Information Security, who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws, Global Perspectives					
MODULE-II					**8 Hours**
Cyber Offenses: How Criminals Plan Them: Introduction, how criminals plan the attacks, Social Engineering, Cyber Stalking, Cyber-caafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector.					
MODULE-III					**8 Hours**
Tools and Methods used in Cybercrime: Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyware, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.					
MODULE-IV					**8 Hours**
Phishing and Identity Theft: Introduction, methods of phishing, phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft.					
MODULE-V					**8 Hours**
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and					

Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics.	
Textbooks:	
1.	"Cyber Security: Sunit Belapure and Nina Godbole, Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition -Reprinted 2018
2.	Introduction to Cyber Security: Guide to the World of Cyber Security "Anand Shinde" Kindle Edition
Reference books:	
1.	"Cyber security", Brain walker,
2.	"Cyber security" Threats and Responses for Government and Business Jack Caravelli, Nigel Jones.
E-References	
1.	https://www.pdfdrive.com/introduction-to-cybersecurity195167204.html
2.	https://www.vlab.co.in/
e–Learning:	
1.	https://www.coursera.org/course/circuits
Internal choice: MODULE- I & IV	
Course outcomes	
CO1: Understand the performance and troubleshoot cyber security systems.	
CO2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation	
CO3: Analyze and evaluate the cyber security needs of an organization	

Course Title	**DATA SCIENCE**				
Course Code	**22EI8PE4DS**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Linear Algebra					
MODULE-I					**8 Hours**
Introduction to Data Science and R Overview of Data Science Role of Data Scientist Data Lifecycle, Data science for engineers Course philosophy and expectation. Definition and Importance of Data Science History and Evolution of Data Science Role of a Data Scientist Tools and Technologies Overview.					

Introduction to R programming. RStudio Environment Setup and Basics-data types, variables, data frames, arithmetic, logical and matrix operations, functions, control structures.	
MODULE-II	**8 Hours**
Data Exploration and Preprocessing Data Collection and Sources Data Cleaning Techniques Exploratory Data Analysis (EDA) **Data Visualization** Principles of Data Visualization Tools and Libraries, Interactive Visualizations Data visualisation in R- basic graphics	
MODULE-III	**8 Hours**
Statistical foundation in R Descriptive and Inferential Statistics, Hypothesis Testing-Basics of Tests of Hypothesis and Decision Rules, Test Procedures for One Sample Test for Mean with Known Variance and unknown variance, Test of Hypothesis for Variance in One and Two Samples. Correlation analysis: Pearson Correlation Coefficient, Spearman Rank Correlation, Point Bi-Serial Correlation and The Phi-Coefficient. Regression Analysis in R	
MODULE-IV	**8 Hours**
Machine Learning Basics with R Supervised Learning Algorithms: Linear Regression, Logistic Regression, Model Evaluation Metrics: RMSE, MAE, ROC, AUC, Unsupervised Learning Techniques: Clustering, PCA Feature Engineering and Selection in R.	
MODULE-V.	**8 Hours**
Big Data Technologies Introduction to Big Data Concepts: Volume, Velocity, Variety, Data Manipulation with data.table and dplyr for Large Datasets. Introduction to Big Data Distributed Computing (e.g., Hadoop, Spark) Data Storage and Retrieval **Ethical Considerations in Data Science** Ethical Considerations in Engineering Data Science Projects Data Privacy Regulations: GDPR, CCPA Regulatory Compliance (e.g., GDPR) **Case Studies:** Application of Data Science Techniques, Real-world Problem Solving, Presentation and Communication Skills	
Textbooks:	
1.	Nina Zumel, John Mount, Practical Data Science with R, Manning Publications, 2014.
2.	W. N Venables, D. M. Smith and the R Core Team, An introduction to R: Notes on R

3.	Data Science and Machine Learning Mathematical and Statistical Method, by Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman
4.	"The Art of Statistics" by David Spiegelhalter
Reference books:	
1.	Data science: theories, models, algorithms and analytics by Sanjiv ran das.
2.	Big Data: Principles and Best Practices of Scalable Real-time Data Systems" by Nathan Marz and James Warren
3.	"Weapons of Math Destruction" by Cathy O'Neil
E-References	
1.	"Engineering Applications of Neural Networks: Concepts, Techniques, and Practices" by K. Y. Lee and S. Y. Chen
2.	"Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce
e–Learning :	
1.	Introduction to R -Software https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2.	Data Science Methodology https://www.coursera.org/learn/data-science-methodology
3.	Data science for engineers https://nptel.ac.in/courses/106106179
Internal choice: MODULE –I & III	
Course outcomes At the end of the course, the student will have the ability to	
CO1: Understand data science principles and the role of R in engineering analytics.	
CO2: Effectively manipulate, clean, and visualize engineering datasets using R's tools.	
CO3: Apply statistical methods, including hypothesis testing and regression, for data-driven engineering decisions.	
CO4: Evaluate and compare machine learning models using appropriate metrics and validation techniques to solve engineering problems.	
CO5: Recognize and address ethical considerations and biases in engineering data science applications	
CO6: Design, execute, and present a data science project addressing a real-world engineering challenge using R.	

Course Title	**DEEP LEARNING**				
Course Code	**22EI8PE4DL**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites: Linear Algebra					

MODULE-I	**8 Hours**
Introduction to Machine Learning and Deep Learning Introduction to AI, ML & Deep learning, Methods and Concepts for AI & ML, Artificial Neural Networks: Basics of Neuron, Perceptron	
MODULE-II	**8 Hours**
Multilayer Neural Network, Back-propagation Algorithm Introduction to Deep Neural Networks, Convolutional Neural Networks, Image Classification using CNN, Recurrent Neural Networks & Auto-encoders, Generative Adversarial Networks (GANs), Support Vector Machines	
MODULE-III	**8 Hours**
Deep Learning in Natural Language Processing Word discovery from real situations, Aligning unsupervised syntax with sensory structures, Machine Translation, Knowledge Discovery Graphs, NELL (Never Ending Language Learning), Case-Studies.	
MODULE-IV	**8 Hours**
Generative AI Image Classification using CNN, Recurrent Neural Networks & Auto-encoders, Generative Adversarial Networks (GANs), Support Vector Machines	
MODULE-V.	**8 Hours**
Applications and Modern Trends Association Rule Mining, Recommendation Systems, Case Studies: MNIST, Boston Housing	
Textbooks:	
1.	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly, 1st Edition, March 2017
2.	Micheal Negnivitsky, Artificial Intelligence: A Guide to Intelligent Systems, Addison-Wesley, 3rd Edition, 2011
Reference books:	
1.	Deep Learning (Adaptive Computation and Machine Learning series), by Aaron Courville, Ian Goodfellow, Yoshua Bengio. MIT Press, 18 November 2016
2.	Deep Learning for Beginners: by Dr. Pablo Rivas, Laura Montoya. Packt Publishing Limited, 18 September 2020
E-References	
1.	Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville
2.	https://machinelearningmastery.com/deep-learning-books/
e–Learning :	

1.	https://archive.nptel.ac.in/courses/106/106/106106184/
2.	https://onlinecourses.nptel.ac.in/noc23_ee87/preview
3.	https://onlinecourses.nptel.ac.in/noc19_cs85/preview

Internal choice: MODULE – Ⅱ & Ⅲ

Course outcomes

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

CO1: Apply deep neural networks in real world problems, understanding their architecture, activation functions, and training procedures

CO2: Develop proficiency in image classification using Convolutional Neural Networks

CO3: Develop proficiency in designing and implementing Recommendation Systems

CO4: Establish a foundational understanding of AI, ML, and Deep Learning

Course Title	**PROJECT -4**				
Course Code	**22EI8PWPW4**	**Credits**	**6**	**L-T-P**	**0:0:6**
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.
- The prototype building 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: Apply fundamental knowledge of measurements and Electronic instrumentation to the solution of complex engineering problem.

CO2: Analyse research-based knowledge to design the system components or processes with appropriate considerations to meet the specifications.

CO3: Use modern tools for modelling and simulation of complex engineering problems to arrive at suitable conclusions.

CO4: Use contextual knowledge relevant to professional engineering practice to address societal needs.

CO5: Comprehend the need for sustainable solutions towards societal, environmental context and apply ethical engineering practise to their work.
CO6: Demonstrate the use of management principles through usage of Gantt chart and make effective presentations and documentations.

Course Title	**INSTRUMENTATION FOR SMART CITIES**				
Course Code	**22EI8OE3SC**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
MODULE-I					**8 Hours**
Micro sensing Networks for sustainable cities: Pollution as a key factor Introduction, urban mega cities, Smart cities, Air pollutants, air pollution sources, water pollutant, water pollutant sources, Air pollution monitoring, Water pollution monitoring, Air quality sensors, water quality sensors. Population growth in Developing countries and smart city fundamentals: Introduction, developing country growth statistics, developed country statistics.					
MODULE-II					**8 Hours**
Harvesting Energy from Ambient Sources Wind Energy, hydropower, Radiation and Mechanical Deformation, Introduction, Ambient Sources, Wind Energy, Hydropower, Photodiodes, Radiation Sources, Piezoelectric Energy, Micro-electromechanical Structures					
MODULE-III					**8 Hours**
Energy Harvesting Devices and Ubiquitous Computing The Sub-systems of an Energy Harvesting Device: **Focus on RFID Fundamentals** Introduction, Radio-Frequency Identification, Sub-system Definitions, Antenna, Rectifier Circuits, Regulator Circuits (Low Dropout Regulator), Amplifier Circuits, Matching Networks, Energy Storage Ubiquitous Computing: Distributing Mobile Computing to Build a Global Network of Things: Introduction, Distributed Computing, Mobile Computing , Evolution of Pervasive Computing, RFID in Ubiquitous Technology , Software in Pervasive Computing Applications ,Human-Centered Pervasive Computing System Model , Pervasive Computing: Thematic Guidelines, Situated Social Context, Social Computing Challenges .					
MODULE-IV					**8 Hours**

Designing and Planning for Sustainable Urbanism with focus on Developing Countries United Nations Millennium Development, Sustainable Resources, responsible Development, Impact Assessment, Social and Economic Metrics, Demographic Considerations, Urban Macro-Effects, Environment Impact Metrics.

MODULE-V.	**8 Hours**

Planning for Sustainable Cities

Tools and Facilitators towards Successful Planning for Sustainable Cities

Population Growth, Smart Cities, Pollution, Ambient Sources and Energy Harvesting, GIS, Remote Sensing and Ubiquitous Computing, Environmental Impact of climate change

Case Study: Developing countries committed to an ecologically aware future:

Categories of sustainable Development, Indicators of Sustainable cities, Worldwide Smart City Initiatives- South Africa- Human Capital in ICT, Information Distribution and transport, Italy- Training Programs in theoretical Physics Aimed at Creating Environmentally Aware and therefore sustainable communities in Developing countries. Sweden-Best practice in mixed use of environmental adaptation in urban areas

Textbooks:

1.	Micro sensing Networks for sustainable cities: 2016 First Edition by Springer International publishing- Smart Sensor, Measurement and instrumentation

Reference books:

1.	Design for sustainability E-Learning Programme - https://www.gaiaeducation.org/index.php/en/online?gclid=CPCoq5Pk9dICFZaOaAodlE8OjQ
2.	Sustainable Cities:https://courses.sdgacademy.org/learn/sustainable-cities-november-2016

E-References

1.	https://www.amazon.in/Microsensing-Networks-Sustainable-Measurement-Instrumentation-ebook/dp/B01AW23N5O

e–Learning :

1.	https://onlinecourses.nptel.ac.in/noc24_ce03/preview
2.	https://www.youtube.com/watch?v=nwVtgIguQRM
3.	https://nptel.ac.in/courses/106106147

Internal choice: MODULE III & V

Course outcomes

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

CO1: Understand the need for sustainable Engineering solutions for Environmental. framework.
CO2: Analyze the requirements of sustainable development for different Environmental. context.
CO3: Develop solution by applying social, economic, Environmental considerations
CO4: Self-study on various cases and presentation of report and seminars

Course Title	**CARBON INITIATIVE FOR CLIMATE**				
Course Code	**22EI8OE3CC**	**Credits**	**3**	**L-T-P**	**3:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Prerequisites:					
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	**INNOVATION FOR ENTREPRENEURSHIP (Common for EEE, ECE , EIE, ETE)**				
Course Code	**22ES8HSIFE**	**Credits**	**2**	**L-T-P**	**2:0:0**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		

Prerequisites: Passion/ Willingness to learn, Enthusiasm to become an entrepreneur.

MODULE-I	**5 Hours**

Ideation and Innovation

Problems and Pain Points, Ideation and Problem Solving, Design Thinking, Team importance and Leadership, Market Segmentation, Beachhead Market, Building End User Profile, Total Addressable Market (TAM) Size for the Beachhead Market, Profile the Persona, Full Lifecycle Use Case, High-Level Product Specification, Quantify the Value Proposition, Identify Your Next 10 Customers, Define Your Core, Chart Your Competitive Position.

MODULE-II	**5 Hours**

Product Acquisition by customer

Determine the Customer's Decision-Making Unit (DMU), Process to Acquire a Paying Customer, Mapping sale process, Total Addressable Market Size for Follow-on Markets

MODULE-III	**5 Hours**

Business from Product

Design a Business Model, set your Pricing Framework, Calculate the Lifetime Value (LTV) of an Acquired Customer, Map the Sales Process to Acquire a Customer, Calculate the Cost of Customer Acquisition (COCA)

MODULE-IV	**5 Hours**

Designing, building and scaling of the product

Identify key Assumptions, Test Key Assumptions, Define and build Minimum Viable Product (MVP), Test with Customer, Repeat Cycle to Reach Product Market Fit.

MODULE-V	**5 Hours**

Startup and Entrepreneurship in India

Starting company in India, IP landscape, Incubation, Government support, Taxation, Startup culture and leadership, Open innovation, Social Innovation, Intrapreneurship, entrepreneurship abroad Simulation of design examples using PCB bundle- ORCAD PCB bundle suite.

Textbooks:	
1.	Disciplined Entrepreneurship: 24 Steps to a Successful Startup (Wiley,1st Edition) Bill Aulet, ISBN: 1118692284, 2013
2.	The Startup Owner's Manual: The Step-by-Step Guide for Building a great company by Steve Blank K&S Ranch Publishers, K&S Ranch, 2016
Reference books:	
1.	Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Christensen, Harvard Business Review Press, 2011.
E-References	
1.	https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring-2013/assignments/assignment-/Ÿ
2.	https://www.edx.org/course/entrepreneurship-101-who-customer-mitx-15-390x
Course outcomes At the end of the course, the student will have the ability to	
CO1: Apply new ideas of design thinking, methods and ways of thinking.	
CO2: Formulate goals as entrepreneur for a startup.	
CO3: Identify business opportunities by performing market research and choosing target customer.	
CO4: Engage with a range of stakeholders to deliver creative and sustainable solutions to specific problems communicate effectively both orally and in writing.	
CO5: Work effectively with peers with diverse skills, experiences and be able to critically reflect on own practice.	

Course Title	**SEMINAR ON INTERNSHIP**				
Course Code	**22EI8SRIN3**	**Credits**	**2**	**L-T-P**	**0:0:2**
CIE	**100 Marks (50% weightage)**	**SEE**	**100 Marks (50% weightage)**		
Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VIII semesters. The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like: 1. Successful completion of Value-Added Programs/Training Programs/workshops organized by academic Institutions and Industries					

2. Soft skill training by the Placement Cell of the college 3. Active association with incubation/ innovation /entrepreneurship cell of institute 4. Participation in Inter-Institute innovation related competitions like Hackathons 5. Working for consultancy/ research project within the institutes. 6. Participation in activities of Institute's Innovation Council, IPR cell, Leadership Talks, Idea/ Design/ Innovation contests 7. Internship with industry/ NGO"s/ Government organizations/Micro/Small/Medium enterprises 8. Development of a new product/ business plan/ registration of a startup long term rural internship For complete details refer: AICTE Internship Polong: Guidelines and Procedures.
Course outcomes At the end of the course, the student will have the ability to
CO1: Conduct a literature review, present and prepare the report.
CO2: Engage in internship in an engineering domain and comprehend the professional norms of the organization.
CO3: Interpret technological solutions, keeping the standard practices and scalability in to consideration.
CO4: Work as an individual towards critical thinking about topics of current trends in chosen technical domain.

Course Title	**MOOCs Course -2**				
Course Code	**22EI8NCMC2**	**Credits**	**-**	**L-T-P**	**-**
Students need to have taken and successfully completed ONE MOOC course (of minimum four weeks duration), from any recognized online platform: NPTEL/SWAYAM/ Coursera/ Edx etc. The courses can be in the Engineering domain, Management domain, Science Domain, Sanskrit / Foreign Language, Art (music/dance/theatre any other), Journalism (media communication or any other), or any domain. Students are awarded a Pass Grade on submission of the successful completion certificate and needs to have taken the course any time after having joined the program.					