KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

"JNANA GANGA" UDYAMBAG, BELAGAVI-590008,
KARNATAKA, INDIA.
Approved by AICTE and UGC
Permanently Affiliated and Autonomous Institution
Under
Visvesvaraya Technological University, Belagavi
www.git.edu

ESTD. 1939

ESTD. 1979

3rd and 4th Semester B.E.

Electronics and Communication Engineering

Scheme and Syllabus (Revised 2022 Scheme w.e.f. AY 2024-25)

INSTITUTION VISION
Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION
To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem-solving ability with an analytical and innovative mindset.

QUALITY POLICY
• Imparting value-added technical education with state-of-the-art technology in a congenial, disciplined and a research-oriented environment. • Fostering cultural, ethical, moral and social values in the human resources of the institution. • Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION
The Electronics & Communication Engineering department shall impart quality technical education and entrepreneurship skills to develop creative individuals to face changing global scenario.

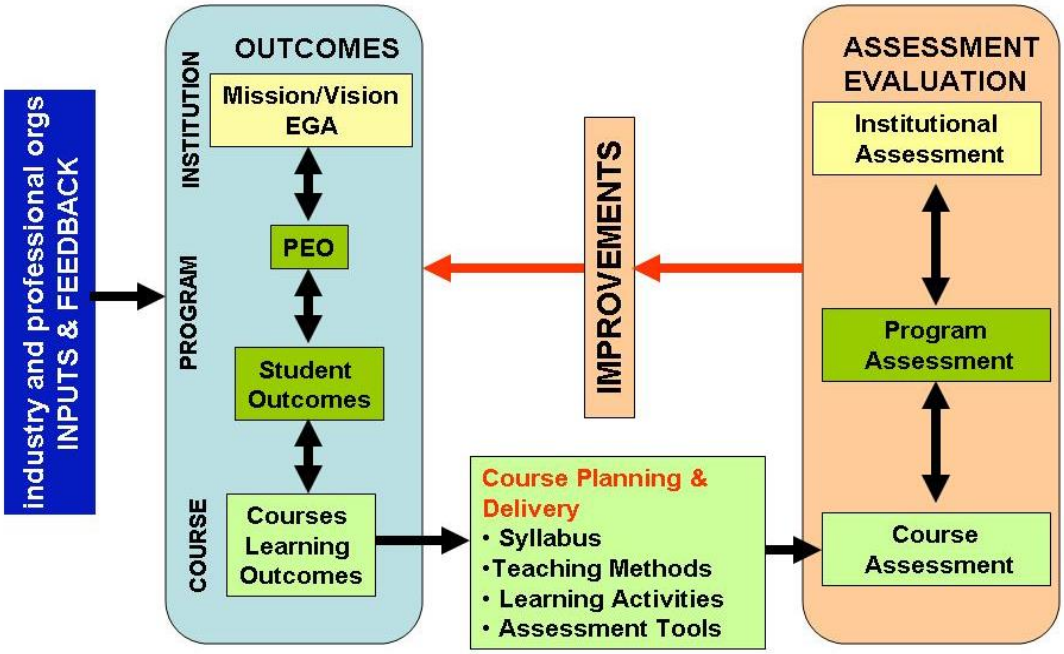
DEPARTMENT MISSION
To augment the national talent pool, with Electronics and Communication Engineers having all-encompassing technical knowledge, principled practices and nationalistic outlook.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
1.	The graduates will acquire core competence in basic science and Electronics and Communication Engineering fundamentals necessary to formulate, analyze, and solve engineering problems and to pursue advanced study or research.
2.	The graduates will engage in the activities that demonstrate desire for ongoing personal and professional growth and self-confidence to adapt to rapid and major changes.
3.	The graduates will maintain high professionalism and ethical standards, effective oral and written communication skills, work as part of teams on multidisciplinary projects under diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.

PROGRAM OUTCOMES (POs)	
1.	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2.	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3.	**Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
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 information to provide valid conclusions.
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.
6.	**The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7.	**Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8.	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9.	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
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.
11.	**Project Management and Finance:** Demonstrate knowledge and understanding of 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.
12.	**Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)	
1.	Understanding and applying the mathematical and scientific concepts, for analysis and design of basic Electronics and Communication systems.
2.	Developing critical thinking abilities coupled with competence in use of computational tools for professional growth; complimented with communication skills and leadership attributes.
3.	Identifying societal needs and sensitizing individuals towards finding innovative solutions to contemporary issues with multidisciplinary outlook.

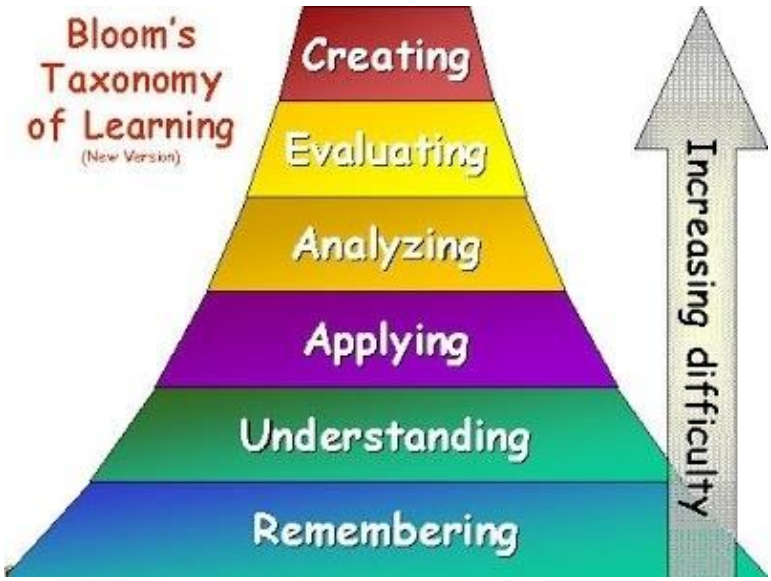
OUTCOME BASED EDUCATION (OBE)



BLOOM'S TAXONOMY OF LEARNING OBJECTIVES

Bloom's Taxonomy in its various forms represents the process of learning. It was developed in 1956 by Benjamin Bloom and modified during the 1990's by a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom's) to make it relevant to the 21stcentury. The **revised taxonomy** given below emphasizes what a learner "Can Do".

Lower order thinking skills (LOTS)		
L1	Remembering	Retrieve relevant knowledge from memory.
L2	Understanding	Construct meaning from instructional material, including oral, written, and graphic communication.
L3	Applying	Carry out or use a procedure in a given situation–using learned knowledge.
Higher order thinking skills (HOTS)		
L4	Analyzing	Breakdown knowledge into its components and determine the relationships of the components to one another and then how they relate to an overall structure or task.
L5	Evaluating	Make judgments based on criteria and standards, using previously learned knowledge.
L6	Creating	Combining or reorganizing elements to form a coherent or functional whole or into a new pattern, structure or idea.



KLS Gogte Institute of Technology
3rd to 8th sem B.E.
Scheme of Teaching and Examination- 2022
Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023-24)

Total credits for B.E. Program: 160

Credit definition:

Offline Courses	Online Courses
• 1-hour Lecture **(L)** per week = 1 Credit • 2 hours Tutorial **(T)** per week = 1 Credit, • 2 hours Practical /Drawing **(P)** per week = 1 Credit	04 weeks =1 Credit 08 weeks = 2 Credit 12 weeks = 3 Credit

Semester wise distribution of credits for B.E program

Year	Semester	Credits	Total/Year	Cumulative Credits
1st	I	20	40	40
	II	20		
2nd	III	20	40	80
	IV	20		
3rd	V	22	40	120
	VI	18		
4th	VII	24	40	160
	VIII	16		
Total			160	

Curriculum frame work:

Structure of Undergraduate Engineering program

S.No.	Category of courses	VTU Breakup of credits	KLSGIT Breakup of credits
1	Humanities and Social Sciences including Management courses (English, Kannada, Indian Constitution, Environmental Sciences and Management)	10	10
2	Basic Science courses	23	22
3	Engineering Science courses including workshop, drawing	20	24
4	Professional Core Courses	46	54
5	Professional Elective courses relevant to chosen specialization/branch	9	12
6	Open subjects – Electives from other technical, emerging, arts commerce and	6	9
7	Mini, Project, Major Project work and Seminar	13	10
8	Summer Internship and Research /Industrial Internship	20	10
9	Ability Enhancement Courses, including Research Methodology, NCC/NSS/ Sports/Ex- Curricular, Online Certification Course	11	7
10	Universal Human Values	2	2
	TOTAL	**160**	**160**

L-T-P Model for Courses

	Contact Hours				Credits	
S.No.	**L-T-P**	**Lecture**	**Tutorial**	**Practical**	**L-T-P**	**Total**
1	3 - 0 - 0	3	0	0	3 - 0 - 0	3
2	3 - 2 - 0	3	2	0	3 - 1 - 0	4
3	3 - 0 - 2	3	0	2	3 - 0 - 1	4
4	2 - 0 - 2	2	0	2	2 - 0 - 1	3
	1 - 0 - 4	1	0	4	1 - 0 - 2	3

Theory courses having the corresponding lab are converted to integrated type course. Also, the electives (if possible) can also be made integrated type.

Integrated courses (Professional Core/Electives): Integrated courses will have **Theory Syllabus with Practical Syllabus of the same course**. In such a course there could be **no Semester End Examination (SEE) for the practical syllabus**of the course, however, Continuous Internal Evaluation (CIE) will be conducted for the practical topics. **SEE should include questions from practical topics.**

SDA-Skill Development Activities, TD/PSB- Teaching Department / Paper Setting Board, ASC-Applied Science Course, ESC- Engineering Science Courses, ETC- Emerging Technology Course, AEC- Ability Enhancement Course, HSMS-Humanity and Social Science and Management Course, SDC- Skill Development Course

KLS Gogte Institute of Technology

2nd Year B.E. Scheme of Teaching and Examination 2022

3rd Semester BE ECE					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	BSC	22MATEC31	Transforms in Signals	Maths	3	0	0	03	3	100	100	200
2	IPCC	22EC32	Applied Electronic Circuits	E & C	3	0	2	05	4	100	100	200
3	IPCC	22EC33	Digital Electronic Circuits	E & C	3	0	2	05	4	100	100	200
4	IPCC	22EC34	Signals and Systems	E & C	3	0	2	05	4	100	100	200
6	ESC	22EC35x	ESC/ETC/PLC	E & C	3	0	0	03	3	100	100	200
					2	0	2*	04				
7	UHV	22EC36	**Social Connect and Responsibility**	E & C	0	0	2	02	1	100	--	100
8	AEC/ SEC	22AECEC37x	Ability Enhancement Course/Skill Enhancement Course - III	E & C	If the course is a Theory			01	1	50	50	100
					1	0	0					
					If a course is a laboratory			02				
					0	0	2					
9	MC	22EC381	National Service Scheme (NSS)/	NSS coordinator	0	0	2	02	0	100	--	100
		22EC382	Physical Education (PE) (Sports and Athletics) and Yoga/	Physical Education dept & Yoga instructor								
		22EC383	Clubs- Social, Cultural & Academic	Coordinators								
Total									**20**	**750**	**550**	**1300**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **S:**SDA: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering. **ESC**: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course

*** 2 – 0 – 2 project-based learning course**

Engineering Science Course (ESC/ETC/PLC)22EC35x			
22EC351	Sensors and Measurements	22EC354	Verilog HDL
22EC352	Healthcare Systems	22EC355	Microcontroller
22EC353	Nano Electronics	22EC356	Data Structures using C
Ability Enhancement Course – III 22AECEC37x			
22AECEC371	Modelling and Simulation for Engineering Applications	22AECEC373	PCB Design
22AECEC372	Design Thinking	**22AECEC374**	**Mathematics I****

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

**** Mandatory for Diploma Lateral Entry Students**

4th Semester BE ECE					Hours/week			Total contact hours/week	Credits	Examination		
S. No.	**Course Type**	**Course Code**	**Course Title**	**Teaching Dept.**	**L**	**T**	**P**			**CIE**	**SEE**	**Total**
1	PCC	22EC41	Applied Electromagnetics	E & C	3	2	0	05	4	100	100	200
2	IPCC	22EC42	Principles of Communication Systems	E & C	3	0	2	05	4	100	100	200
3	IPCC	22EC43	Control Systems	E & C	3	0	2	05	4	100	100	200
5	ESC	22EC44x	ESC/ETC/PLC	E & C	3	0	0	03	3	100	100	200
					2	0	2*	04				
6	AEC/ SEC	22AECEC45x	Ability Enhancement Course/Skill Enhancement Course- IV	E & C	If the course is Theory			01	1	50	50	100
					1	0	0					
					If the course is a lab			02				
					0	0	2					
7	BSC	22EC46	Biology For Engineers	Medical Sciences	3	0	0	03	3	100	100	200
8	UHV	22EC47	Universal human values course	E & C	1	0	0	01	1	50	50	100
9	MC	22EC481	National Service Scheme (NSS)/	NSS coordinator	0	0	2	02	**0**	100	--	100
		22EC482	Physical Education (PE) (Sports and Athletics) and Yoga/	Physical Education dept & Yoga instructor								
		22EC483	Clubs- Social, Cultural & Academic	Coordinators								
Total									**20**	**700**	**600**	**1300**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering.

*** 2 – 0 – 2 project-based learning course**

Engineering Science Course (ESC/ETC/PLC) 22EC44x			
22EC441	Applied Probability Theory and Random Processes for Communication and ML	22EC445	Verilog HDL

22EC442	Sensors and Measurements	22EC446	Microcontroller
22EC443	Healthcare Systems	22EC447	Data Structures using C
22EC444	Nano Electronics		
Ability Enhancement Course / Skill Enhancement Course – IV 22AECEC45x			
22AECEC451	Modelling and Simulation for Engineering Applications	22AECEC453	PCB Design
22AECEC452	Design Thinking	**22AECEC454**	**Mathematics II****

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

**** Mandatory for Diploma Lateral Entry Students**

TRANSFORMS IN SIGNALS

Course Code	22MATEC31	Course type	BSC	Credits L-T-P	3 – 0 – 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40Hrs; T = 0Hrs;P = 0Hrs Total = 40Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Learn Fourier analysis of periodic and non-periodic systems.
2.	Get acquainted with discrete and continuous time functions and their Fourier Analysis.
3.	Study the frequency response for circuits using Laplace Transforms

Pre-requisites: Integration and differentiation.

Unit – I	Contact Hours = 8 Hours
Fundamentals and transmission through LTI: Signal (Examples and classification of singles). Basic operations on signals. Basic Continuous –Time Signals and Basic Discreet –Time Signals (Unit step function, Unit impulse function, Ramp function, Exponential signals, Sinusoidal signals, exponentially damped sinusoidal signals and pulse signals.) System. Properties of system (Linearity, Causality, Time –invariance and Stability.)Response of a linear system (The Zero –input, Zero-state and total response)	

Unit – II	Contact Hours = 8 Hours
Fourier Analysis of continuous time signals: Classification of time functions – continuous, discrete, periodic and non-periodic functions. Fourier analysis of continuous time periodic functions using continuous time Fourier series (CTFS), properties of CTFS (proof not necessary), Numericals. Fourier analysis of continuous time non-periodic functions using continuous time Fourier transform (CTFT), properties of CTFT(proof not necessary), relationship between CTFS and CTFT, numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit –III	Contact Hours = 8 Hours
Fourier Analysis of discrete time functions: Fourier analysis of discrete time periodic functions using discrete time Fourier series (DTFS), properties of DTFS(proof not necessary), Numericals. Fourier analysis of discrete time non-periodic functions using discrete time Fourier transform(DTFT), properties of DTFT(proof not necessary), relationship between DTFS and DTFT, Numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit – IV	Contact Hours = 8 Hours
Laplace transforms: Definition of Laplace transforms. Region of convergence. Poles and Zeros of rational Laplace Transforms. Properties of Region of convergence. Laplace transforms for common signals. Properties of Laplace transforms (Linearity, time shifting, Shifting in s-domain, time scaling, time-domain integration, Differentiation if time-domain, differentiation in s-domain, convolution) Partial fraction expansion. Unilateral Laplace transform. Initial value theorem, Final value theorem. Waveform synthesis, Relationship between Laplace Transform and Fourier transform. Numerical pertaining to standard continuous time functions.	

Unit –V	Contact Hours = 8 Hours
Z- transforms: Definition. z-transform and ROC of finite duration sequences (Right sided, Left-sided and double –sided sequences), z-transform and ROC of Infinite duration sequences (Positive-time, Negative-side and Double –sided exponential sequence), ROC and stability. Properties of z-transform. **Inverse Z-transforms:** Partial fraction expansion method, long division method and complex inverse integral. Linear constant coefficient difference equations. Relation between Z-transform and, discrete time Fourier transform and Laplace transform. Numerical pertaining to standard discrete time functions.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Dr. D. Ganesh Rao, “Signals and Systems”, Sanguine Tech. Publ., 2011.
2.	H. Hsu and R. Ranjan, “SIGNALS AND SYSTEMS”, 2ndedition, Schaum’s Outline Series,
3.	P. Z. Peebles, “Probability, Random Variables, and Random Signal Principles”, McGraw Hill, 4th edition, 2017 and onwards.
	Reference Books:
1.	Simon Haykin and Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley, 2003 and onwards.
2.	A. Anand Kumar, “Signals and Systems “, 3rd Edition, PHI Learning.
	E-resourses (NPTEL/SWAYAM.. Any Other)
2.	https://nptel.ac.in/courses/117105085 (**Fourier Analysis of discrete time functions**)

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Assignments (OBA)
4.	Online classes	4.	Course Seminar

		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand and Apply Fourier Analysis for periodic and non-periodic signals.**	Ap	1	1
2.	**Apply DTFS and DTFT to deal with analysis of Discrete Signals.**	Ap	1	1
3.	**Apply Laplace Transforms and Z transforms to analyze the signals.**	Ap	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2	✓												✓		
3	✓												✓		
Tick mark(✓)															

KLS GOGTE INSTITUTE OF TECHNOLOGY BELGAUM

APPLIED ELECTRONIC CIRCUITS

Course Code	**22EC32**	**Course type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To learn various network theorems, node voltage and mesh current methods to simplify and find solution to electrical circuits.
2.	To understand the circuit applications that involve diodes such as clippers, clampers etc. Also design and compare biasing circuits for BJT and FET amplifiers and study the ac operation of the BJT and FETs via small signal modeling.
5.	To study the fundamentals of MOSFET's and non-ideal characteristics.

Required Knowledge of: Basic Electronics(22BEE13)

Unit – I	**Contact Hours = 8 Hours**
Basics of Network Analysis: Star-Delta Transformation, Power supplies in Series and parallel combination, Mesh analysis, Node Analysis, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem (only DC analysis). Case Study: Analysis of electrical circuits using Superposition Theorem.	

Unit – II	**Contact Hours = 8 Hours**
Semiconductor diode applications: Design of clipper circuits. **Transistor Biasing:** Operating point, Fixed bias circuit, Emitter stabilized biased circuit, Voltage divider bias circuit, Numerical. Case Study: Design of Clamper circuits.	

Unit – III	**Contact Hours = 8 Hours**
BJT modelling: BJT transistor modelling, Hybrid equivalent model, (common emitter configuration only) **FET Biasing:** Introduction, Fixed bias circuit, Self-bias circuit, Voltage divider bias circuit for n-channel JFET, JFET small signal model, AC analysis of common source JFET Fixed-Bias Amplifier circuit. Case Study: AC analysis of JFET Source Follower (Common-Drain) Configuration.	

Unit – IV	Contact Hours = 8 Hours
MOSFET's: Introduction, Construction, basic operation and characteristics of: Depletion-type MOSFET and Enhancement-type MOSFET, Depletion-type MOSFET ac equivalent model, Enhancement type MOSFET ac equivalent model. Case Study: Voltage divider biasing arrangement for n-channel enhancement MOSFET.	

Unit – V	Contact Hours = 8 Hours
MOS Transistor Theory: Introduction, ideal I-V characteristics, long-channel I-V characteristics, C-V characterization, simple MOS capacitance models, detailed MOS gate capacitance model, detailed MOS diffusion capacitance model; non-ideal I-V effects: DC transfer characteristics, β ratio effects, noise margin. Case Study: 2nd order effects, β effects.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	2	a) Mesh analysis for DC circuits b) Node analysis for DC circuits
1	2	a) Verification of Thevenin's Theorem b) Verification Maximum Power Transfer Theorem
2	2	a) Diode Clipping Circuits b) Diode Clamping Circuits
2	1	Transistor biasing using Fixed bias and voltage divider bias
3	1	BJT RC coupled amplifier
4	1	FET amplifier
3	1	MOSFET Characteristics
5	1	MOSFET Amplifier using simulation tool

Unit No.	Self-Study Topics
1	Reciprocity theorem, Millman's theorem
2	Collector feedback biasing circuit
3	Hybrid Equivalent model for Common collector configuration
4	Feedback biasing arrangement for n-channel enhancement MOSFET
5	Digital Controlled Analog switch using CMOS

Books	
	Text Books:
1.	ME Van Valkenburg, Network Analysis, Prentice Hall of India, 3rd Edition, 2000.
2.	D. Roy Choudhury, "Networks and Systems", New Age International, 1st edition, 1998.
3.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education, 9th Edition and onwards.
4.	Neil Weste, and David Harris, "CMOS VLSI Design, A Circuits and Systems Perspective",4th Edition; Pearson Education, India.
	Reference Books:
1.	Jacob Millman & Christos C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2nd Edition, 2010 and onwards.
2.	David A. Bell, "Electronic Devices and Circuits", PHI, 4th Edition, 2004 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Apply the knowledge network theorems for a given electrical networks	Ap	1,2,3,5,12	1
2.	Analyze the performance of transistor circuit parameters.	An	1,2,3,5,12	1
3.	Design /analyze the transistor amplifier circuits for the desired operating characteristics.	An	1,2,3,5,9,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	

30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks				
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PS O3**
1	✓	✓	✓		✓							✓	✓		
2	✓	✓	✓		✓							✓	✓		
3	✓	✓	✓		✓				✓			✓	✓		
Use tick mark(✓)															

DIGITAL ELECTRONIC CIRCUITS

Course Code	**22EC33**	**Course type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study the various Boolean minimization techniques applied to digital circuits for optimal circuit design.
2.	To gain knowledge in the design of optimal combinational circuits.
3.	To gain knowledge in the design of sequential circuits with the fundamental study of flip-flops.
4.	To understand and design sequential circuits.

Required Knowledge of : Basic Electronics(22BEE13)

Unit – I	**Contact Hours = 8 Hours**
Fundamentals of Digital Design: General Digital Design sequence, Canonical Expressions, Karnaugh maps- 3 and 4 variables, Incompletely specified functions (Don't Care terms), Realization of Boolean functions.	

Unit – II	**Contact Hours = 8 Hours**
Design of Combinational Circuits -I: Design of Adders and subtractors, Ripple adder, adder/subtractor, Look-ahead adder, Magnitude Comparator,	

Unit – III	**Contact Hours = 8 Hours**
Design of Combinational Circuits-II: Design using - Encoders, Decoders, Multiplexers. Programmable Logic Devices (PROM, PLA, PAL). Boolean function implementation using PLDs.	

Unit – IV	**Contact Hours = 8 Hours**
Elements of Sequential Circuits: Basic bi-stable element, Latches, Timing parameters, A switch debouncer, The gated latches, Race-around condition, Master-Slave Flip-Flops, Edge triggered flip-flops. Characteristic Equations. Excitation table.	

Unit – V	Contact Hours = 8 Hours
Sequential Logic Circuits: Registers, Counters (Ripple, Synchronous counters), Counters based on Shift Registers, Design of Synchronous counters using JK, D, T, and SR flip flops. Introduction to Mealy and Moore models. Sequence detectors.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	1	Problem statement implementation and verification using gates.
2	2	Verification of arithmetic circuits and comparator.
3	3	Study of encoder ICs, design and verification using decoders and multiplexers.
4	1	Study of flip-flops ICs and verification of conversion of flip-flops.
5	1	Verification of SISO, SIPO, PISO, PIPO operations of shift register, ring and Johnson counters.
5	2	Study of counter ICs, Design and verification of mod-N counters.

Unit No.	Self-Study Topics
1	Tabulation method of simplification of Boolean functions.
2	Decimal adder.
3	Boolean function implementation using PLDs.
4	Conversion of flip-flops.
5	FSMs.

Books	
	Text Books:
1.	Donald D. Givone, “Digital Principles and Design”, McGraw-Hill, 1st Edition, 2002.
2.	John M Yarbrough, “Digital Logic Application and Design”, Thomas Learning, 2001.
	Reference Books:
1.	Donald P. Leach, Albert Paul Malvino, GoutamSaha, “Digital Principles and Applications”, Tata McGraw-Hill, Sixth Edition
2.	ZVI Kohavi, “Switching and Finite Automata Theory”, TMH
3.	Thomas L. Floyd, “Digital logic fundamentals”, Pearson Education, 11th Edition, 2014.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1.	NPTEL - https://onlinecourses.nptel.ac.in/noc21_ee75/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Understand the fundamental principles of design of digital circuits	Un	1,12	1
2.	Apply the concepts of digital fundamentals to design optimal digital circuits for the given specifications.	Ap	1,3,12	1
3.	Implement and verify the digital circuits using ICs.	Ap	1,3,9,10,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks

IA Test:
1. No objective part in IA question paper
2. All questions descriptive

Conduct of Lab:
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks

Lab test: (Batchwise with 15 students/batch)
1. Test will be conducted at the end of the semester
2. Timetable, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE:
1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE**
2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.**
3. Lab test is COMPULSORY
4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.**
5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓											✓	✓		
2	✓		✓									✓	✓		
3	✓		✓						✓	✓		✓	✓		
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Design and Verification of Digital circuits	Embedded Systems	System Designer

Name & Signature of Faculty members involved in designing the syllabus

(Dr. Suresh C. Kuri)

Name & Signature of Faculty members verifying/approving the syllabus

SIGNALS AND SYSTEMS

Course Code	**22EC34**	**Course type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To Apply time and Transform domain techniques to Continuous / Discrete time signals and systems and analyse their performance.
2.	To apply Continuous / Discrete convolution methods for computing response of LTI systems and analyse their performance.
3.	To Apply various transform domain techniques to Signals and Systems and analyse their performance.

Pre-requisites:
Engineering Mathematics

Unit – I	**Contact Hours = 8 Hours**
Introduction: Definitions of a Continuous / Discrete time signal Classification of signals, Elementary signals Basic Mathematical Operations on Continuous / Discrete time signals, Convolution, Convolution Integral and Convolution sum, Apply the knowledge to study the characteristics of practically available impulse, step, ramp, energy and power signals. Apply the mathematical operations to the existing signals using practically realizable circuits and study their response. **Case Study:** Study of various real life 1 dimensional, 2 dimensional and 3 dimensional signals. Study of single channel, double channel and multichannel signals.	

Unit – II	**Contact Hours = 8 Hours**
Time-domain representations for LTI systems: Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations of systems. Introduction to State Space representation of Continuous / Discrete time Systems with examples. Apply the knowledge to the mathematical modelling of few important systems like,RC Circuit,RL Circuit.	

Unit – III	**Contact Hours = 8 Hours**
Statement of Uniform Sampling Theorem, proof, sketching the spectrum of sampled signal for given sampling rate, Nyquist Sampling rate, Computation of Nyquist Sampling rate, Parseval's Relation for CT signals, numerical as applicable.	

Apply the knowledge to sample a given signal using practical sampler circuit for over sampling,under sampling and Nyquist rate of sampling and observe the effects of aliasing.

Unit – IV	**Contact Hours = 8 Hours**
Z – Transforms: Introduction, Z – transform, properties of ROC, properties of Z – transforms, Inversion of Z transforms (IZT using Contour integration): Computation of IZT using long division, power series and Partial Fraction method, Transform analysis of LTI Systems. Apply the Z-Transform techniques to perform frequency domain analysis of differentiator,integrator. Practically compute the unit impulse,step,steady state response of LPF and HPF.	

Unit – V	**Contact Hours = 8 Hours**
Fourier representation for energy signals: Discrete and continuous Fourier transforms and their properties, computation of DTFT and CTFT of standard signals like Unit Impulse, Unit Step, Rectangular Pulse, Right Sided and Two-Sided exponential signal, Signum function, Sine and Cosine functions. Apply the knowledge to observe the frequency domain representation of above-mentioned standard signals using Spectrum Analyzer and analyse the effects of frequency components present in the signal. DTFS and CTFS are special cases of DTFT and CTFT. **Case Study:** Orthogonal signals, Orthonormal signals, orthonormal basis functions (Fourier Basis functions).	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No	**No. of Experiments**	**Topics related to experiment**
1	**2**	**Generation of standard signals and mathematical operations.**
2	**2**	**Verification of System properties**
3	**2**	**Computation of Z and IZT of signals, Computation of unit impulse and step response of a system**
4	**2**	**Computation of DTFT and CTFT of signals, Computation of frequency response of a system.**
5	**2**	**Verification of sampling theorem for different sampling rates. And Verification Parseval's theorem**

Self-Study Topics

Unit No.	**Self-study Topics**
1	**Identify the practical applications of Standard Signals**
2	**Study unit impulse response characteristics of R, L, C, RC and RL circuits.**
3	**Computation of IZT using Contour integration methods.**
4	**Frequency response analysis of LPF and HPF filters**
5	**Study effect of aliasing.**

Books	
	Text Books:
1.	Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley & Sons, Second edition March 2021 and onwards.
2.	M J Roberts "Signals and Systems "McGraw-Hill, 2018 edition and onwards
	Reference Books:
1.	Alan V. Oppenheim, Alan S. Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002 and onwards**.**
2.	H. P Hsu, R. Ranjan, "Signals and Systems", Schaum's outline, TMH, 2006 and onwards.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Appraise the fundamental concepts of Signals and Systems, principles, theories, and terminology used in the course.	Ap	1	1
2.	Apply transform domain principles and practices for Spectral Analysis of Signals and Systems.	Ap	1,4,5	1
3.	To develop expertise in the field of Signals and systems to solve practical problems practical problems.	An	1,4,5	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks				

4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓		✓	✓				✓	✓			✓	✓	
2	✓	✓		✓	✓				✓	✓		✓	✓	✓	
3	✓	✓		✓	✓		✓		✓	✓			✓	✓	
Use tick mark(✓)															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**

1	Analyze CT/DT Signals and Systems both in time and frequency domain.	Communication and Signal Processing, Automobile Industry	Electronic System Designer and Analyzer
2	pectral Analysis of a given signal using Transform domain technique		

APPLIED PROBABILITY THEORY AND RANDOM PROCESSES FOR COMMUNICATION AND ML

Course Code	**22EC441**	**Course type**	**ESC**	**Credits L-T-P**	3 – 0 – 0
Hours/week: L – T – P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	--			**SEE Marks**	100

Course learning objectives	
1.	Understand Random Variables and relevant terminology
2.	Get accustomed to, operations on single and pairs of random variables and their interpretation
3.	Get acquainted with multiple random variables
4.	Understand random and Markov processes.

Pre-requisites: Basic Linear Algebra, vector algebra and vector calculus, basic statistics

Unit – I	**Contact Hours = 8 Hours**
Random Variables, Distributions, and Density Functions: The Cumulative Distribution Function, The Probability Density Function, The Gaussian Random Variable. Other Important Random Variables, Conditional Distribution and Density Functions, Engineering Application: Reliability and Failure rate.	

Unit – II	**Contact Hours = 8 Hours**
Operations on a single random variable and pairs of random variables: Expected Value of a Random Variable Expected Values of Functions of Random Variables Moments. Central Moments Conditional Expected Values. Transformations of Random Variables Characteristic Functions. Probability-Generating Functions. Moment-Generating Functions Evaluating Tail Probabilities, Engineering Application—Scalar Quantization Engineering Application—Entropy and Joint Cumulative Distribution Functions Joint Probability Density Functions Joint Probability Mass Functions. Conditional Distribution, Density, and Mass Functions. Expected Values Involving Pairs of Random Variables. Independent Random Variables Jointly Gaussian Random Variables Joint Characteristic and Related Functions. Transformations of Pairs of Random Variables Complex Random Variables.	

Unit – III	**Contact Hours = 8 Hours**
Multiple random Variables:Joint and Conditional PMFs, CDFs, and PDFs Expectations Involving Multiple Random Variables Gaussian Random Variables in Multiple Dimensions. Transformations Involving Multiple Random Variables Estimation and Detection Engineering Application: Linear Prediction of Speech	

Unit – IV	Contact Hours = 8 Hours
Random sums and sequences: Independent and Identically Distributed Random Variables. Convergence Modes of Random Sequences. The Law of Large Numbers The Central Limit Theorem. Confidence Intervals. Random Sums of Random Variables, Engineering Application: A Radar System	

Unit – V	Contact Hours = 8 Hours
Random Processes and Markov Processes: Definition and Classification of Processes. Mathematical Tools for Studying Random Processes Stationary and Ergodic Random Processes. Properties of the Autocorrelation Function Gaussian Random Processes. Poisson Processes, Definition and Examples of Markov Processes Calculating Transition and State Probabilities in Markov Chains Characterization of Markov Chains. Continuous Time Markov Processes. Engineering Application: A Computer Communication Network. Engineering Application: A Telephone Exchange	

Books	
	Text Books:
1.	Scott L. Miller and Donald Childers, "Probability and Random Processes with Applications to Signal Processing and Communications". Academic Press, Elsevier Inc 2nd edition 2012 onwards.
2.	Henry Stark, John Woods "Probability and Random Processes with applications to signal Processing" PHI Learning Private Limited, Delhi ISBN: 978-81-203-4245-3 3 rd Edition onwards.
	Reference Books:
1.	Robert M Gray, "Probability and Random Processes and Ergodic Properties" Springer 2nd Edition onwards.
2.	J. Ravichandran,"Probability & Random Processes For Engineers"
	E-Resourses (NPTEL/SWAYAM.. Any Other)
1.	
2.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)
At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Understand** random variable and related statistic	Un	1	1
2.	**Understand** the engg applications of single and pair of random variables.	Un	1	1
3.	**Apply** the theory of multiple random variables in estimation and detection**.**	Ap	1	1
4.	**Apply** theory of Random processes to communication network.	Ap	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2	✓												✓		
3	✓												✓		
4	✓												✓		
Use tick mark(✓)															

SENSORS AND MEASUREMENTS

Course Code	**22EC351 / 22EC442**	**Course type**	**ESC**	**Credits L-T-P**	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities.
2.	To understand the concept of measurements and errors happen during measurements
3.	Study of Digital Acquisition systems and its applications

Pre-requisites : Basic Electronics (22BEE13)

Unit – I	**Contact Hours = 8 Hours**
Gross Errors and Systematic Errors, Absolute and Relative Errors, Accuracy, Precision, Resolution and Significant Figures, Units and standards, sensor, transducer, classification of transducers, Requirement of transducers, Static characteristics, dynamic characteristics.	

Unit – II	**Contact Hours = 8 Hours**
Transducers - I Introduction, Electrical Transducers, Selecting a Transducer, Resistive Transducer, Resistive Position Transducer, Strain Gauges, Resistance Thermometer, Thermistor, Inductive Transducer, Differential Output Transducers and LVDT.(principle, types & list of characteristics only)	

Unit – III	**Contact Hours = 8 Hours**
Transducers - II: Piezoelectric Transducer, Photoelectric Transducer, Photovoltaic Transducer, Semiconductor Photo Devices, Temperature Transducers – RTD, Thermocouple.(principle, types & list of characteristics only)	

Unit – IV	**Contact Hours = 8 Hours**
Miscellaneous Sensors and Transducers: Noise (sound)Sensors, Speed Sensors, Thickness Measurement, Weatherstations. Piezoelectric transducer, Hall Effect transducers, Smartsensors, Fiber optic sensors, Film sensors, MEMS, Nano sensors,Digital transducers.	

Unit –V	**Contact Hours = 8 Hours**

Data Acquisition: Types of transducers, signals, signal conditioning, DAQ hardware, analog inputs and outputs, DAQ software architecture, selection and configuration of data acquisition device, components of computer based measurement system **Case Study: SCADA**

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Sawhney. A.K**,** "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai& Company Private Limited,2007.
2.	C. S. Rangan, G. R. Sarma, V. S. V. Mani , Instrumentation: Devices and Systems, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014.
3.	H. S. Kalsi, "Electronic Instrumentation", TMH, 2004.
4.	David A. Bell, "Electronic Instrumentation and Measurements", PHI, 2006
5.	Murthy.D.V.S, "Transducers and Instrumentation", Prentice Hall of India,2001
	Reference Books:
1.	Doebelin. E.A, "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2000.
2.	John. P, Bentley, "Principles of Measurement Systems", III Edition, Pearson Education, 2000.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar/Course Project
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Use concepts in common methods for converting a physical parameter into an electrical quantity	Un	2	1
2.	Classify and explain the different types of transducers.	Ap	3,12	2

3.	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration	An	2,9,12	1
4.	Analyze usage of transducers in data acquisition and developing a measurement system depending on the application	An	2,9,10,11,12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1		✓											✓		
2			✓									✓		✓	
3		✓							✓			✓	✓		
4		✓							✓	✓	✓	✓		✓	
Use tick mark(✓)															

HEALTHCARE SYSTEMS

Course Code	**22EC352 / 22EC443**	**Course type**	**ETC**	**Credits L-T-P**	3 – 0 – 0
Hours/week: L – T – P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	05 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the Historical Perspective of modern healthcare system.
2.	To study ethical practices in Health care.
3.	To learn the origin of biopotential in neuron cell and various potential measurement techniques.
4.	To understand cardiological signal processing.
5.	To understand various patient monitoring systems.

Pre-requisites: Engineering Mathematics, Basic Electronics

Unit – I	**Contact Hours = 8 Hours**

Introduction to Biomedical Engineering:
The Evolution of the Modern Health Care System, The Modern Health Care System, Biomedical Engineering, Roles Played by the Biomedical Engineers, Recent Advances in Biomedical Engineering, Professional Status of Biomedical Engineering, Professional Societies.

Unit – II	**Contact Hours = 8 Hours**

Ethical Practices in Health Care:
Morality and Ethics: A Definition of Terms, Two Moral Norms: Beneficence and Nonmaleficence, Human Experimentation, Definition and Purpose of Experimentation, Informed Consent, Regulation of Medical Device Innovation, Marketing Medical Devices, Ethical Issues in Feasibility Studies, Ethical Issues in Emergency Use, Ethical Issues in Treatment Use, The Role of the Biomedical Engineer in the FDA Process.

Unit – III	**Contact Hours = 8 Hours**

Anatomy and Physiology: Introduction-Cellular organization, Plasma membrane, Tissues, Homeostasis. Bioelectric phenomena: Origin of bio-potentials - Notion of Hodgkin-Huxley model of the action potential, Biopotential measurements – ECG, EEG, EMG, ERG.

Unit – IV	**Contact Hours = 8 Hours**

Analysis of Bio signals:
Cardiological Signal Processing: Methods in Recording ECG, Waves and Intervals of ECG, ECG DataAcquisition, ECG Parameters and Their Estimation, ECG QRS Detection Technique, Template MatchingTechnique, Differentiation Based QRS Detection Technique, Simple QRS width Detection Algorithm, HighSpeed QRS detection Algorithm, Estimation of R-R Interval, Estimation of ST Segment.

Unit – V	**Contact Hours = 8 Hours**

Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors; Measurement of Heart Rate, Pulse Rate, Blood Pressure, Temperature, Respiration Rate; Arrhythmia Monitor and Ambulatory Monitoring Instruments; Foetal Monitoring Instruments: Cardiotocograph, Monitoring Foetal Heart Rate and Labour Activity.

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	1	1	1	1	1

Books	
	Text Books:
1.	J. Enderle, S. Blanchard, J. Bronzino, "Introduction to Biomedical Engineering", Elsevier Academic Press, 2009
2.	R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill Publishing Company Limited, 2ndedition, 2003.
	Reference Books:
3.	J.G. Webster, "Medical Instrumentation: Application and Design", John Wileyand Sons, 2003.
4.	L. Sornmo, P. Laguna, "Bioelectrical Signal Processing in Cardiac and Neurological 6Applications", Elsevier Academic Press, 2005.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
		4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the evolution of the Modern Health Care System and ethical practices in health care system.	Un	6, 7, 8, 9, 12	2
2.	**Understand** theorigin ofbioelectric potential for neuron cell, various biopotential measurement techniques and **analyze** the cardiological bio signals to detect heart related problems.	An	1,4,5, 6, 7, 8, 9, 12	2
3.	Understand the components and working of medical instrumentation/monitoring systems.	Un	1,6, 7, 8, 9, 12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1						✓	✓	✓	✓			✓		✓	
2	✓			✓	✓	✓	✓	✓	✓			✓		✓	
3	✓					✓	✓	✓	✓			✓		✓	
Use tick mark(✓)															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Academic competence	GE Healthcare	Sales Executive/Engineer
2	ability to work as a part of a multidisciplinary team	Siemens	Research and development
3		Cardiac Labs	Service Engineer

Name & Signature of Faculty members
involved in designing the syllabus

Name & Signature of Faculty members
verifying/approving the syllabus

NANO ELECTRONICS

Course Code	**22EC353 / 22EC444**	**Course type**	ETC	**Credits L-T-P**	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	4 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the principles of nano-science engineering, carbon nanotubes and their applications.
2.	To understand the effects of size of nano-materials on various applications.
3.	To study the fabrication techniques of nano particles.
4.	To identify the properties of nanoparticles and their usage in various applications.

Pre-requisites : Basic physics and chemistry

Unit – I	**Contact Hours = 8 Hours**
Introduction: Overview of nano-science and engineering, Development milestones in micro-fabrication and electronic industry, Moore's law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction. **Case Study:** Effects of nano-meter length scale	

Unit – II	**Contact Hours = 8 Hours**
Characterization: Classification, Field ion microscopy, Scanning probe techniques, Diffraction techniques: Bulk and surface diffraction techniques **Inorganic semiconductor nanostructures:** Overview of semiconductor physics, Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets. **Case Study:** Electronic density of states	

Unit – III	**Contact Hours = 8 Hours**
Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nano-materials, Ordering of nano systems **Fabrication techniques:** Requirements of ideal semiconductor, Epitaxial growth of quantum wells, Lithography and etching, Cleaved-edge over growth, Growth of vicinal substrates, Strain induced dots and wires, Electrostatically induced dots and wires, Quantum well width fluctuations, Thermally	

annealed quantum wells, Semiconductor nanocrystals, Colloidal quantum dots, Self-assembly techniques. **Case Study**: Fabrication of Semiconductor Nanocrystals

Unit – IV	**Contact Hours = 8 Hours**
Characterization of semiconductor nanostructures: Optical, electrical and structural **Carbon Nanostructures:** Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes. **Case Study:** Fabrication of carbon nanotubes	

Unit – V	**Contact Hours = 8 Hours**
Nano sensors: Introduction, Sensors and nano-sensors, Order from Chaos, Characterization, perception, Nano sensors based on quantum size effects, Electrochemical sensors, Sensors based on physical properties, Nano biosensors, Smart dust sensor for the future **Applications:** Injection lasers, Quantum cascade lasers, Single-photon sources, Biological tagging, Optical memories, Coulomb blockade devices, Photonic structures, QWIP's, NEMS, MEMS. **Case Study:** Applications of Nano sensors	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**0**	**0**	**2**	**2**	**0**

Books	
	Text Books:
1.	Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology, John Wiley, 2007. (Unit 1, 2, 3 and 4)
2.	Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011. (Unit 4)
3.	T Pradeep, —Nano: The Essentials-Understanding Nanoscience and Nanotechnology, TMH. (Unit 5)
	Reference Books:
1.	William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Fundamentals of micro and nanofabrication By Prof. Shankar Selvaraja, Prof. Sushobhan Avasthi, IISc Bangalore https://onlinecourses.nptel.ac.in/noc20_bt37/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)

		4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to(Highlight the **action verb** representing the learning level				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the principles of Nano-electronics, properties of Nano-particles and carbon nanotubes	Un	1,9,10,12	1
2.	Apply concepts of nano-electronics in various fields	Ap	1,2,9,10,12	1,2
3.	Understand the fabrication techniques and Analyze the process flow for sensor design.	Un, An	1,2,3,8,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓								✓	✓		✓	✓		
2	✓	✓							✓	✓		✓	✓	✓	

3	✓	✓	✓					✓	✓	✓		✓	✓		✓
Use tick mark(✓)															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Students will be able to understand the basic concepts, fabrication methods and applications of Nano Science, Nano Electronics.	Sensor designing, Semiconductors	Entry level researcher/ Research assistant, Entry level Application Engineer, Entry level Design Engineer

Name & Signature of Faculty members members involved in designing the syllabus

Name & Signature of Faculty verifying/approving the syllabus

VERILOG HDL PROGRAMMING

Course Code	**22EC354 / 22EC445**	**Course type**	**PLC**	**Credits L-T-P**	2 – 0 – 1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 20Hrs; T = 0 Hrs; P = 40 Hrs Total = 60Hrs			**CIE Marks**	100
Flipped Classes content	5 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basic language features of Verilog HDL and the role of HDL in digital logic design.
2.	To implement combinational and simple sequential circuits using different modelling styles
3.	To develop behavioral modelling of algorithmic state machines.
4.	To analyze the synthesis of combinational and sequential descriptions.

Required Knowledge of: Basic Electronics (22BEE13), Digital Electronic Circuits (22EC33)

Unit – I	**Contact Hours = Hours**
IntroductiontoHDL(Verilog): VerilogasHDL, Typical Design Flow, Importance of HDLs, modules, Instances, Design block, Stimulus block. **Basic Concepts:** Lexical conventions, Data Types, System Tasks and Compiler Directives. Modules, ports.	

Unit – II	**Contact Hours = Hours**
Gatelevel Modelling: Gate Types, Gate Delays **Dataflow Modelling:** Continuous Assignments, Expressions, Operators, and Operands, Operator Types, Examples	

Unit – III	**Contact Hours = Hours**
Behavioral Modelling: Structured Procedures, Procedural Assignments, Timing controls, Conditional Statements, Multiway Branching, Loops, Generate Blocks, Examples.	

Unit – IV	**Contact Hours = Hours**
Tasks and Functions: Difference between Tasks and Functions, Tasks, Functions, Examples	

Unit – V	**Contact Hours = Hours**
Logic Synthesis with Verilog HDL: Verilog HDL Synthesis, Synthesis Design Flow, An example of RTL-to-Gates, Examples of Sequential Circuit Synthesis.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**

No. for Flipped Classroom Sessions	1	1	1	1	1

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
2,3		a) Verilog description for full-adder using structural modeling. b) Verilog description for full-adder using behavioral modeling.
2,3		Verilog description for n-bit ripple carry full-adder using 1-bit full-adder.
2,3		a) Verilog description for BCD to seven segment decoder for common anode display using if else. b) Verilog description for BCD to seven segment decoder using case statement.
2		a) Verilog description for 4 -bit parallel adder. b) Verilog description for 4-bit comparator.
2,3,4,5		a) Verilog description for 4-to-1 multiplexer using logic equations. b) Verilog description for 4-to-1 multiplexer using conditional operators. c) Verilog description for 4-to-1 multiplexer using behavioral modeling. d) Verilog description for 4-to-1 multiplexer using 2:1 multiplexers.
2,3,4,5		a) Verilog description for 3-to-8 decoder using logic equations. b) Verilog description for 3-to-8 decoder using structural modeling c) Verilog description for 3-to-8 decoder using behavioral modeling. d) Verilog description for 3-to-8 decoder using 2-to-4 decoders.
		a) Verilog description of 4:2 priority encoder using logic equations b) Verilog description of 4:2 priority encoder using casex/casez statement
2,3,4,5		a) Verilog description for edge-triggered SR-flip flop. b) Verilog description for edge-triggered D-flip flop. c) Verilog description for edge-triggered JK-flip flop. d) Verilog description for edge-triggered T-flip flop.
2,3,4,5		a) Verilog description for 4-bit ripple carry counter using T-flip flop. b) Verilog description for 4-bit synchronous counter using JK-flip flop. c) Verilog description for BCD up/down counter using behavior modeling d) Verilog description of random sequence generator using case statement.
2,3,4,5		a) Verilog description for right shift register. b) Verilog description for left shift register c) Verilog description for Universal shift register
3,5		Verilog description for 8-bit ALU.

Unit No.	Self-Study Topics
2,3,4,5	Boolean function implementation using MUX and its Verilog code
2,3,4,5	Boolean function implementation using decoder and its Verilog code
2,3,4,5	Verilog description for conversion of flip-flops
2,3,4,5	Verilog description for mod-n counters
2,3,4,5	Verilog description for ring and Johnson counters

Books	
	Text Books:
1.	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.
	Reference Books:
1.	Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition.
2.	Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	http://nptel.ac.in/video.php?subjectId=106105083

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem

Course Outcome (COs)

Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Understand the basics of Hardware Description Languages, Program structure and basic language elements of Verilog Understand types of modelling, modules, functions of Verilog and simulate and synthesize related Programs.	Un	1	1
2.	Design, Simulate and synthesize various Verilog descriptions for combinational and sequential blocks.	Ap	1,3,5	1
3.	Perform the timing and power analysis of combinational and sequential blocks.	An		1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		PROJECT (60 marks)			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks
Theory IA test should be of one-hour duration. Lab IA test should be of two/three-hour duration. Project batch will ideally consist of 2 students (maximum of 3).					

Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester. Submitting Project report is compulsory.
Eligibility for SEE: 1. 40% and above (16 marks and above) in theory component 2. 40% and above (24 marks and above) in project component 3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome b. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2	✓		✓		✓				✓	✓		✓	✓		
3	✓		✓		✓				✓	✓		✓	✓		
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Digital System Design and Analysis using Verilog HDL	Chip Design	Design Engineer

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MICROCONTROLLER

Course Code	22EC355 / 22EC446	**Course type**	**PLC**	**Credits L-T-P**	2 – 0 – 1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 30 Hrs; T = Hrs; P = 20 Hrs Total = 50 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basics of microcontrollers architectures and its functionalities.
2.	To develop an in-depth understanding of the operation of microcontrollers.
3.	Apply the knowledge of the assembly language programs to develop
4.	To design and develop microcontroller-based designs for real time applications using High level programming.

Pre-requisites: Digital design, number systems

Unit – I	**Contact Hours = 6 Hours**
Introduction toMicrocontrollers: Introduction toMicroprocessor & Microcontroller, Von Neumann Vs Harvard Architecture, CISC vs RISC architectures. Evolution of the Embedded Microcontrollers, Embedded Systems components and their peripherals.	

Unit – II	**Contact Hours = 6 Hours**
Microcontroller Architecture: 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	

Unit – III	**Contact Hours = 6 Hours**
Introduction to Assembly language: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Stack related instructions. Assembly language program examples.	

Unit – IV	**Contact Hours = 6 Hours**
Introduction to embedded C: Introduction to embedded C, advantages, C versus embedded C, compiler vs cross compiler. Storage classes – auto, register, static & extern. Data types, library functions, Timer modes- Mode1, Mode2 programming	

Unit – V	**Contact Hours = 6 Hours**
Programming using embedded C: High level language programs onSimple switch operation, Buzzer, LED & I/O ports programs for waveform generation. Logical operators and their related programs, Code conversions.	

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No.of Experiments	PART-A
2	2	1. Addition & subtraction of two 8/16-bit numbers (Using Registers & Memory) 2. ALP to transfer block of data from one memory locations to another memory locations.
3	2	3. ALP to sum of first 'n' natural numbers. 4. ALP to transfer block of data from one memory locations to another memory locations
4	2	5. Write a program to send hex values for ASCII characters of 0, 1, 2, 3, 4, 5,6, 7, 8, 9, A, B, C, D and E to port P1. 6. Program to toggle bits of P1 with time delay, Program to read a byte from P1, wait 1/2 second and then send to P2.
5	3	7. Write an 8051 C program to toggle bits of P1 ports continuously with a 250 ms. 8. A door sensor is connected to the P1.1 pin, and a buzzer is connected to P1.7. Write an 8051 C program to monitor the door sensor, and when it opens, sound the buzzer. You can sound the buzzer by sending a square wave of a few hundred Hz. 9. Write an 8051 C program to convert packed BCD to ASCII and display the bytes on P1 and P2.
	1	PART-B 10. Each student needs to formulate a problem definition in consultation with the guide for the Project component and work towards completion after approval. Project report has to be submitted by each student individually.

Unit No.	Self-Study Topics
1	Evolution of microcontrollers up to 64 bits
2	Identify and list the Multiplexed pins of 8051 Architecture
3	Understanding of the I/O ports for the read and Write operations.
4	Understand the C library header files and directives used for the programs related to sensor interfacing
5	Develop HLL program to students attendance system wherein a switch is to be pressed by a student and the count to be displayed on 7 segment LED.

Books	
	Text Books:
1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay , The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e (Second Edition ,Pearson Education)
2.	K. J. Ayala, D. V. Gadre , The 8051 Microcontroller & Embedded Systems using Assembly and C (Cengage Learning , India Edition)
3.	Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005
	Reference Books:
1.	Manish K Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links

1.	https://nptel.ac.in/courses/117104072 - (Microcontrollers & Applications IIT, Kanpur)
2.	https://nptel.ac.in/courses/117104072 - (Introduction to Microcontrollers & Microprocessor, IIT Kanpur

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem
5	Virtual Labs (if present)	5.	

Course Outcome (COs) **At the end of the course, the student will be able to (Highlight the action verb representing the learning level.)**				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand difference between Microprocessors & Microcontrollers and their architectures.	Un	1,2	1
2.	Apply the knowledge of assembly language to perform data computation	Ap	1,2,3	1
3.	Apply the knowledge of embedded c for writing programs on real time data analytics and conversion.	Ap	1,2,5,12	1

Scheme of Continuous Internal Evaluation (CIE):
For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (COMPULSORY) will be part of the CIE. No SEE for Lab.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks

Theory IA test should be of one-hour duration.
Lab IA test should be of two/three-hour duration.
Project batch will ideally consist of 2 students (maximum of 3).
Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester.
Submitting Project report is compulsory.

Eligibility for SEE:
1. 40% and above (16 marks and above) in theory component
2. 40% and above (24 marks and above) in project component
3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks

	Project evaluation d. Initial write up stating the objectives, methodology and the outcome e. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. f. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓		
2	✓	✓	✓										✓		
3	✓	✓			✓							✓	✓		
Tick mark✓ the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	ALP Programming using microcontrollers	Embedded & device drivers	Embedded design engineer
2	C programming for the Microcontroller	Embedded & device drivers	Embedded system engineer

DATA STRUCTURES USING C

Course Code	**22EC356 / 22EC447**	**Course type**	**Integrated Project based PLC**	**Credits L-T-P**	2 – 0 – 1
Hours/week: L - T- P	2 – 0– 2			**Total credits**	3
Total Contact Hours	L = Hrs; T = Hrs; P = Hrs Total = 40Hrs			**CIE Marks**	100
Flipped Classes content	5 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the concepts and usage of stack, queue, and list abstract data types.
2.	To comprehend the prefix, infix, and postfix expression formats.
3.	To gain knowledge about the implementation of trees and searching-sorting algorithms.
4.	To analyse and evaluate the performance of basic linear data structure implementations.

Required Knowledge of: C Programming

Unit – I	**Contact Hours = 4 Hours**
Basic Concepts: Meaning of data structure, Algorithm efficiency, Complexity of algorithms, Time-Space trade-off, String Processing, Arrays- one and two dim arrays, Structures, Pointers **Recursion**: Understanding the concept of recursion.	

Unit – II	**Contact Hours = 4 Hours**
Lists: List Operations: Insertion operation, Deletion operation, List implementation using arrays and linked lists. List Variants and Applications: Singly linked lists, doubly linked lists, circularly linked list and their implementations.	

Unit – III	**Contact Hours = 4 Hours**
Stack: Introduction to Stacks, Stack Operations, Stack Applications- Infix to postfix conversion using stacks.	

Unit – IV	**Contact Hours = 4 Hours**
Queue: Introduction to Queues, Key characteristics of queues (FIFO principle), Queue Operations: Enqueue, Dequeue, removing elements from the queue, Accessing the front and rear elements, Circular queues and their implementation.	

Unit – V	**Contact Hours = 4 Hours**
Binary Trees: Operations on binary trees, Binary tree Representations, tree traversal. **Sorting & Searching**: Sorting – Bubble sort, Quick sort, Linear search, Binary search.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**1**	**1**	**1**	**1**	**1**

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**1**	Writing program to calculate Factorial, Fibonacci numbers.
1	**2**	Writing recursive programs to translate from Prefix to postfix using Recursion.
2	**3**	To write program to create singly linked list and perform the following function a) Insertion b) Deletion c) Searching d) Display
3	**4**	To write a menu driven program to implement a stack and perform the following operations on the stack- (i)Push (ii) Pop (iii)Peep (iv) Display
4	**5**	To write a menu driven program to implement a queue (using array and linked list) and perform the following operations. - (i) Insert (ii) Delete (iv) Display.
5	**6**	To arrange the numbers in ascending order using Bubble sort.
5	**7**	To arrange the numbers in ascending order using Quick sort.
	8	To search an element in an array using linear search.
5	**9**	To search an element in an array using Binary search.

Unit No.	Self-Study Topics
1	Difference between Recursion and Iteration, Recursive problem-solving approach Designing and implementing recursive functions
2	Searching a linked list
3	Evaluation of postfix expressions using stacks
4	Priority queues
5	Binary tree applications

Books	
	Text Books:
1.	Seymour Lipschutz, "Theory and Problems of Data Structure" (Schaum's Outline Series), Tata-McGraw-Hill.
2.	Richard F. Gilberg and Behrouz Forouzan, "Data Structure- A Pseudo code approach with C", Thomson India Edition
	Reference Books:
1.	Yedidyah, Augenstein, Tannenbaum, "Data Structures Using C and C++",2nd Edition, Pearson Education, 2003 and onwards.
2.	Horowitz, Sahni and Anderson-Freed, "Fundamentals of Data Structures in C", 2ndEdition, Universities Press, 2007 and onwards.
	Debasis Samanta,"Classic Data Structures", 2ndEdition, PHI, 2009 and onwards

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem

5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand fundamental data structures and their operations, including arrays, Stacks, Ques and linked lists.	Un	1,2,3	1
2.	Apply recursion to solve problems and implement recursive algorithms.	Ap	1,2,3	1
3.	Analyse and compare the efficiency of different sorting algorithms, such as Bubble sort, quick sort.	An	1,2,3	1
4	Design and implement advanced data structures, such as binary trees and utilize it to solve complex problems efficiently.	Cr	1,2,3	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks

Theory IA test should be of one-hour duration.
Lab IA test should be of two/three-hour duration.
Project batch will ideally consist of 2 students (maximum of 3).
Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester.
Submitting Project report is compulsory.

Eligibility for SEE:

1. 40% and above (16 marks and above) in theory component
2. 40% and above (24 marks and above) in project component
3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	**Lab Open ended program/problem/experiment** Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation g. Initial write up stating the objectives, methodology and the outcome h. Hardware project: Exhibiting and demonstration of working of project.	10 marks 30 marks	

	Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. i. Viva-voce	10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓										✓		
2	✓	✓	✓										✓		
3	✓	✓	✓										✓		
4	✓	✓	✓										✓		
Tick mark✓ the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Algorithmic Thinking, Data Organization, Efficiency Analysis	Science and Analytics, Database Management.	Data Scientist, Database Administrator

SOCIAL CONNECT AND RESPONSIBILITY

Course Code	**22EC36**	**Course type**	**UHV**	**Credits L-T-P**	0 – 0 – 1
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1
Total Contact Hours	16 Hours of engagement			**CIE Marks**	100
Flipped Classes content	--			**SEE Marks**	--

Course learning objectives	
1.	Bridging the gap between theory and practice through community engagement
2.	Interaction with the community for identification and solution to real life problems faced by the community
3.	Catalyzing acquisition of values and responsibilities for public service to make better citizens

Required Knowledge of: Interpersonal skills, Communication skills

Activities to be planned and conducted by the Department Associations are:

1. **Linking learning with the community through Knowledge Sharing**: In this the students can apply their knowledge and skills to improve the lives of the people. The knowledge available with the students can be shared to the school students of the local community. It can be in the form of engaging the classes, developing projects which can used by the students and teachers, training sessions on MS word, Excel, PPT for students and teachers etc.
2. **Creating Awareness about health and hygiene:** The students can arrange talks on Importance of cleanliness, health, and hygiene by taking help of Doctors, Public Health Organizations, NGOs etc.
3. **Including the Practitioners as teachers:** Arrange the invited talks by experts in agriculture for the farmers in the local community to create awareness about Organic farming, new methods of agriculture such as hydroponics, vertical farming etc.
4. **Environmental Sustainability:** Students can take initiatives to educate the local community regarding protecting our environment through tree plantations, preserving water bodies etc.
5. **Social Innovations for Rural development**

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Gain knowledge about the culture and societal realities	Un	6,9	
2.	Develop sense of responsibility and bond with the local community	Un	6,9	
3.	Make significant contributions to the local community and the Society at large	Ap	6,9	

4	Identify opportunities for contribution to the Socio-economic development	Ev	6,9	

Scheme of Continuous Internal Evaluation (CIE):

• Students must maintain the diary of the activities conducted. • The activities can be conducted in groups/batches. • Faculty members can design the evaluation system wherein weightage can be given to presentation of activities conducted & report writing.	50 marks

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1						✓			✓						
2						✓			✓						
3						✓			✓						
4						✓			✓						
5															
Tick mark the CO, PO and PSO mapping															

MODELLING AND SIMULATION FOR ENGINEERING APPLICATIONS

Course Code	**22AECEC371 / 22AECEC451**	**Course type**	**AEC**	**Credits L-T-P**	0 – 0 – 1
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 21 Hrs Total = 21 Hrs			**CIE Marks**	50
Flipped Classes content	3 Hours			**SEE Marks**	50

Course learning objectives	
1.	To introduce students to the block diagram-based approach to modelling of systems
2.	To gain knowledge about Simulink to solve Electronics Engineering, Electrical engineering and mechanical engineering problems.
3.	To provide an opportunity to students to develop inter-disciplinary skills and bridge the skill gaps to make students industry ready.

Required Knowledge of: MATLAB

Unit – I	**Contact Hours = 7 Hours**
Simulink Software Overview Need of Simulink, Concept of Modeling of systems, Accessing Toolbar & Libraries, Simulink Graphical Environment, Simulink Block Diagrams: Working with Blocks, Block Settings, Overview of Libraries, Create Simple Models	

Unit – II	**Contact Hours = 7 Hours**
Engineering fundamentals using Simulink: Electronics engineering concepts using Simscape	

Unit – III	**Contact Hours = 7 Hours**
Simulink and Hardware Interfacing: Install the required Arduino Hardware Support Packages for MATLAB & Simulink. **SIMULINK used for Real Life Applications**: Modelling and Simulation of the Vehicle Suspension System, DC Servo Motor & Tank Level Control, Implement Fan control, Helicopter model control	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**
No. for Flipped Classroom Sessions	**1**	**1**	**1**

List of Experiments

Unit No.	**No. of Experiments**	**Topic(s) related to Experiment**
1	**5**	Half Adder Circuit, Full Adder Circuit, Circular Motion, Projectile Motion, Simple Harmonic Motion
2	**3**	Half and Full wave Rectifiers, Diode Circuits, Amplifiers

3	**2**	Blink LED without writing a single line of code using Simulink, communicate with the target board (Arduino) using external mode by changing the brightness of an LED with PWM

Unit No.	**Self-Study Topics**
3	**Basics of Servo Motor**
3	**PID controller**

Books	
	Text Books:
1.	Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", OXFORD Higher Education.
2.	Dr. Shailendra Jain, "Modeling & Simulation using MATLAB – Simulink", Wiley – India.
	Reference Books:
1.	Steven T. Karris, "Introduction to Simulink with Engineering Applications", Orchard Publications.
2.	MATLAB Manuals and Handbooks

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests- Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open-ended problem
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Use block diagram-based approach to simulate various systems	Ap	1,3,5,6,9,10,12	1,2
2.	Analyze a complex task and break it up into smaller, simpler tasks	An	2,3,5,9,10,11,12	1,2,3
3.	Apply the knowledge gained to develop new and creative solutions to real life problems	An	1,3,5,6,9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1. Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:

1. 40% and above (20 marks and above)

2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass: Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.**		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓		✓	✓			✓	✓		✓	✓	✓	
2		✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
3	✓		✓		✓	✓			✓	✓	✓	✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Modeling of systems using Simulink**	**Any mechanical or Electronics industry**	**System Modeling Engineer, Software tester**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

DESIGN THINKING

Course Code	**22AECEC372 / 22AECEC452**	**Course type**	**AEC**	**Credits L-T-P**	0 – 0 – 1
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 20Hrs Total = 20Hrs			**CIE Marks**	50
Flipped Classes content	-			**SEE Marks**	50

Course learning objectives	
1.	Expose students to the design process as a tool for innovation and preparing them to tackle complex design challenges.
2.	Develop students' professional skills and demonstratethe value of developing a local network.
3.	Provide an authentic opportunity for students to develop teamwork and leadership skills and develop a portfolio of work to set them apart in the market.

Pre-requisites: NA

Lab Experiment – I Introduction	**Contact Hours = 2 Hours**
Step 1 of Design Thinking: Empathizing (In group exhaustive listing of societal issues and problems)	
Lab Experiment – 2 Define	**Contact Hours = 2 Hours**
Step 2 of Design Thinking: Defining (Clubbing the exhaustive problems in categories, in priority of immediate to last based on attention and solution needed)	
Lab Experiment – 3 Ideation	**Contact Hours = 2 Hours**
Step 3 of Design Thinking: Ideate (After selection of one group of problem statement, for an idea selecting the single problem)	
Lab Experiment – 4 Ideation	**Contact Hours = 2 Hours**
Step 3 of Design Thinking: Ideate (Gathering solutions from other groups for selected problem)	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Step 3 of Design Thinking: Ideate (Preparing a storyline for the problem)	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Step 3 of Design Thinking: Ideate (Feel activity for the empathy part of the problem)	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Step 4 of Design Thinking: Prototype (Presentation of a model or process of the idea)	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Step 5 of Design Thinking: Testing or Validation (Model or the Idea or the project is tested or validated)	

Books	
	Text Books:
1.	Engineering Design: A Systematic Approach by Gerhard Pahl, W. Beitz , JörgFeldhusen, Karl-Heinrich Grote
2.	Product Design and Development byUlrich, Karl T., Eppinger,Steve D.and Yang, Maria C.,7th ed., McGraw-Hill Education.
	Reference Books:
1.	Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn
	E-resources (NPTEL/SWAYAM.. Any Other)
1.	Product Engineering and Design ThinkingBy Prof. Pranab K Dan , Prof. Prabir Sarkar | IIT Kharagpur, IIT RoparLink: https://onlinecourses.nptel.ac.in/noc23_me52/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Activity and Presentation
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
		3.	Semester End Examination (Practical)

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Discuss the process as a tool for innovation and tackle complex design challenges.	Un	2,3	1, 2
2.	Develop professional skills and demonstratethe value of developing a local network.	Ap	6,10	1
3.	Develop a portfolio of work to set themselves apart in the market.	Ev	6,9	2, 3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

4. Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks
5. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
6. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:

2. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass: Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.**		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1		✓	✓										✓	✓	
2						✓				✓			✓		
3						✓			✓					✓	✓

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	**Analytical Thinking**	**IT, Core, Electronics**	**Engineering and Administrative**
2	**Team Building**	**IT, Core**	**Team Lead, Project Manager**
3	**Time Management, Lon-Short Term Planning**	**IT, Core**	**Team Lead, Program Manager**

PCB DESIGN

Course Code	22AECEC373 / 22AECEC453	Course type	AEC	Credits L-T-P	0 – 0 – 1
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 24 Hrs Total = 24 Hrs			**CIE Marks**	50
Flipped Classes content	0 Hrs			**SEE Marks**	50

Course learning objectives	
1.	Introduce PCB designing.
2.	Explore open-source software for prototyping of PCB.
3.	Introduce design rules and PCB fabrication techniques.

Pre-requisites: Basic Electronics.

Unit – I	**Contact Hours = 2 Hours**
Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.	

Unit – II	**Contact Hours = 2 Hours**
Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications,	

Unit – III	**Contact Hours = 20 Hours**
Introduction to Electronic design automation (EDA) tools for PCB designing: Brief Introduction of open-source PCB software (EasyEDA), Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, creating report of design like bill of materials (BoM), creating manufacturing data (GERBER) for design. **PCB Production:** Toner transfer heat and heatless processes. Chemical Etching using FeCl3, PCB drilling, soldering techniques.	

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment

1	**2**	Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components
2	**2**	Net listing, PCB Layout Designing, Auto routing and manual routing.
3	**3**	Assigning specific text (silkscreen) to design, creating report of design like bill of materials (BoM), creating manufacturing data (GERBER) for design. PCB fabrication using toner transfer method and chemical etching, drilling and soldering.

Books	
	Text Books:
1.	Printed circuit board design, fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006 onwards.
2.	Printed Circuits Handbook, Sixth Edition,by Clyde F. Coombs, Jr, Happy T. Holden,Publisher: McGraw-Hill Education2016 onwards.
	Reference Books:
1.	Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002 onwards.
2.	C. Robertson. PCB Designer´s Reference. Prentice Hall, 2003 onwards.

Course delivery methods		**Assessment methods**	
1.	PPT and Videos	1.	IA test
2.	Practice session/Demonstrations in Labs	2.	Project

Course Outcome (COs)

At the end of the course, the student will be able to(Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand basics of PCB design	Un	1,3	1,2
2.	Design PCB layouts for different applications taking appropriate design rules into consideration	Ap,An	2,3,5, 9,10,11,12	1,2,3
3.	Fabricate PCB boards for a given application	Cr	2,3,9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

7. Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks
8. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
9. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:

3. 40% and above (20 marks and above) 2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass: Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.**		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓		✓										✓	✓	
2		✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
3		✓	✓						✓	✓	✓	✓	✓	✓	✓
Use tick mark(✓)															

Sl. No.	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Designing PCB Layouts	Any core Electronics Industry such as Mobile manufacturing, Automotive, R and D sector.	Electronics Circuit Design Engineer, Project Leader, Research Scholar
2	Fabrication of PCB		

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

MATHEMATICS I

(For EE/EC Stream Diploma Students)

CourseCode	22AECEC374	**Coursetype**	**AEC**	**Credits L – T – P**	1 – 0 – 0
Hours/week:L-T-P	1 – 0 – 0			**Total credits**	1
TotalContactHours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIE Marks**	50
Flipped Classes Content	5 Hours			**SEE Marks**	50

Course learning objectives	
1.	Review basic differentiation
2.	Get acquainted with different applications of partial differentiation
3.	Get familiar with various topics in Linear Algebra.
5.	Understand the basic concepts of multiple integral.

Required Knowledge of: Basic Trigonometry, Calculus, Algebra

Unit– I: Calculus	**Contact Hours = 5Hours**
Introduction to limits, continuity and differentiation: Polar Curves, angle between radius vector and tangent, angle between polar curves, Radius of curvature (Cartesian and polar form)	

Unit–II: Partial Differentiation	**Contact Hours = 5Hours**
Definition and simple problems. Total Differentiation-Problems. Partial Differentiation of Composite functions – Problems. Maxima and minima of function of two variables. Jacobians.	

Unit – III: Linear Algebra I	**Contact Hours = 5Hours**
Rank of a matrix by elementary transformation, consistency of system of linear equations-Gauss Jordan method and Gauss-Seidal method. Eigen value and Eigen vectors – Rayleigh's Power method.	

Unit– IV: Multiple Integrals	**Contact Hours = 5Hours**
Cylindrical and spherical polar coordinates. Evaluation of double and triple integrals, evaluation ofdouble integrals by change of order of integration, changing into polar coordinates. Applications to find: Area and Volume by double integral. Problems	

Flipped Classroom Details

Unit No.	I	II	III	IV
No. for flipped Classroom Sessions	1	1	1	2

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006.
3.	B. V. Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

Coursedeliverymethods		Assessmentmethods	
1.	ChalkandTalk	1.	IAtests
2.	PPT andVideos	2.	OpenBookAssignments(OBA)/LabProject
3.	FlippedClasses	3.	LabTest
4.	Practicesession/DemonstrationsinLabs	4.	SemesterEndExamination
5.	VirtualLabs(ifpresent)		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

		Learning Level	PO(s)	PSO(s)
1.	**Review** basics of Differentiation and Integration	Re	1	1
2.	**Review** basic concepts of Calculus.	Re	1	1
3.	**Understand** basic Linear Algebra	Un	1	1
4.	**Understand** multivariable Calculus.	Un	1	1

CO-POMapping(planned)													CO-PSO Mapping(planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	✓												✓		
2	✓												✓		
3	✓												✓		
4	✓												✓		
Use tick mark (✓)															

Scheme of Continuous Internal Evaluation (CIE): Theory course (Non-Integrated)

Components	Addition of CIE components	TotalMarks
Written Test	30	50
Two quizzes	20	

Scheme of Semester End Examination (SEE): Theory course (Non-Integrated)

Components	TotalMarks
Written exams	**50**

MATHEMATICS II

(For EC/EE stream Diploma Students)

CourseCode	22AECEC454	**Course type**	**AEC**	**CreditsL-T-P**	1 – 0 – 0
Hours/week:L-T-P	1 – 0 – 0			**Totalcredits**	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIEMarks**	50
Flipped Classes content	5 Hours			**SEEMarks**	50

Course learning objectives	
1.	Learn advanced linear algebra.
2.	Get familiar with Laplace transforms, and various properties associated with them.
3.	Learn Inverse and use Laplace Transform to solve differential equation
4.	Learn and use various concepts in vector differentiation and vector Integration.

Required Knowledge of: Basic Trigonometry, Calculus, Algebra

Unit– I: Linear algebra II	**Contact Hours = 5 Hours**
Diagonalization of a square matrix, Orthogonal matrix Quadratic form and reduction to Canonical forms by Orthogonal Transformation. Linear Transformation. Regular transformation. Special transformations	

Unit–II: Laplace Transforms	**Contact Hours =5 Hours**
Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence, Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s-domain, division by t, differentiation and integration in the time domain, LT of special functions periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function	

Unit – III: Inverse Laplace Transform	**Contact Hours = 5 Hours**
Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and Applications to solve ordinary differential equations	

Unit– IV: Vector Calculus	**Contact Hours =5Hours**
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Greens theorem and Stokes theorem. Problems	

Flipped Classroom Details

Unit No.	I	II	III	IV
No. for Flipped Classroom Sessions	1	1	1	2

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006.
3.	B. V. Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

Course delivery methods		Assessment methods	
1.	ChalkandTalk	1.	IAtests
2.	PPT andVideos	2.	OpenBookAssignments(OBA)/LabProject
3.	FlippedClasses	3.	LabTest
4.	Practicesession/DemonstrationsinLabs	4.	SemesterEndExamination
5.	VirtualLabs(ifpresent)		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Understand** advanced Linear Algebra.	Re	1	1
2.	**Understand** concepts of Laplace Transforms.	Re	1	1
3.	**Understand** concepts of Inverse Laplace transforms.	Un	1	1
4.	**Understand** vector differentiation and Integration**.**	Un	1	1

CO-POMapping(planned)													CO-PSO Mapping(planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	✓												✓		
2	✓												✓		
3	✓												✓		
4	✓												✓		
Use tick mark (✓)															

Scheme of Continuous Internal Evaluation (CIE): Theory course (Non-Integrated)

Components	Addition of CIE components	TotalMarks
Written Test	30	50
Two quizzes	20	

Scheme of Semester End Examination (SEE): Theory course (Non-Integrated)

Components	TotalMarks
Written exams	**50**

APPLIED ELECTROMAGNETICS

Course Code	22EC41	**Course type**	PCC	**Credits L-T-P**	3 – 1 – 0
Hours/week: L - T- P	3 – 2 – 0			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 20 Hrs; P = 0 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	--			**SEE Marks**	100

Course learning objectives	
1.	To understand the concepts of static electromagnetic (EM) fields.
2.	To develop comprehensive and rigorous treatment of time varying EM fields.
3.	To develop a comprehensive treatment to various antenna and waveguiding applications.

Requires Knowledge of: Engineering Mathematics.

Unit – I	**Contact Hours = 8 Hours**
Review of Vectors analysis: Vector algebra, vector calculus - divergence, gradient, curl, Laplacian; Coordinate systems - Cartesian, cylindrical and spherical; **Electrostatics:** Coulomb's law, Gauss's law, electric scalar potential, Laplace and Poisson's equations, conduction and polarization, boundary conditions, resistance and capacitance;	

Unit – II	**Contact Hours = 8 Hours**
Magnetostatics: Biot-Savart law, Ampere's law, magnetic vector potential, Lorentz force, magnetization, boundary conditions, magnetic energy and inductance;	

Unit – III	**Contact Hours = 8 Hours**
Electrodynamics: Maxwell's equations, Faraday's induction, displacement current, Plane wave propagation in free space and in materials; Poynting vector, reflection and transmission of plane waves at media boundary, Transmission lines, Smith chart;	

Unit – IV	**Contact Hours = 8 Hours**
Applications of Electromagnetics – I: **Antenna fundamentals:** Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Bandwidth, Antenna Field Zones & Polarization. **Dipole antenna:** EM Fields(General and Far Field Analyses), Radiation Resistance of a Short and $\lambda/2$Electric Dipoles.	

Unit – V	**Contact Hours = 8 Hours**
Applications of Electromagnetics – II: Microstrip transmission lines. **Wave guiding structures:** TE mode in the infinite Parallel Plane transmission line or guide, Hollow rectangular waveguide, Hollow Cylindrical waveguide and waveguide devices. Dielectric sheet waveguides – fiber optics.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions					

Books	
	Text Books:
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 6th Edition, 2014 and onwards.
2.	JohnD.Krauss,"Electromagnetics with Applications", 5thEdition,McGraw-Hill International, 1999 and onwards.
3.	D. K. Cheng, 'Field and Wave Electromagnetics,' Addison-Wesley series, 1989
	Reference Books:
1.	William H.Hayt Jr. and John A. Buck, "Engineering Electromagnetics", Mc.Graw-Hill Education, 2nd Edition, 2014 and onwards.
2.	Joseph A. Edminister, "Theory and Problems on Electromagnetics", Schaum's outline series,Mc.Graw-Hill, 2nd Edition, 1993 and onwards.
3.	C.A.Balanis,"AntennaTheoryAnalysisandDesign",3rdEdition,JohnWileyIndia Pvt. Ltd., 2008 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Introduction to Electromagnetic Theory (IIT Kanpur) https://nptel.ac.in/courses/115104088

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Apply the concepts of static electromagnetic fields to relevant problems.	Ap	1, 4, 5	1,2
2.	Analyze time varying electromagnetic fields to engineering applications of electromagnetic.	An	1, 4, 5	1,2
3.	Analyze the electromagnetic fields of antenna and waveguiding structures.	An	4, 5, 12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks

Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓			✓	✓								✓	✓	
2	✓			✓	✓							✓	✓	✓	
3				✓	✓								✓	✓	
Use tick mark(✓)															

PRINCIPLES OF COMMUNICATION SYSTEMS

Course Code	**22EC42**	**Course type**	**IPCC**	**Credits L-T-P**	3 – 0 – 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To compare different continuous wave modulation techniques and applications of FM
2.	To analyze sampling theory and waveform coding techniques
3.	To analyze communication channel performance and source coding techniques

Pre-requisites: Basic Electronics Engineering

Unit – I	**Contact Hours = 8 Hours**
Random Process: Random variables: Several random variables. Statistical averages: Function of Random variables, moments, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross – correlation functions. Introduction to noise: Shot noise, Thermal Noise, White Noise, Numerical	

Unit – II	**Contact Hours = 8 Hours**
Continuous Wave Modulation: Introduction and review of Amplitude modulation, Comparison of different AM techniques, Angle Modulation: Frequency Modulation: Narrow band Frequency modulation, wide band FM, transmission band width of FM waves, generation of FM waves: Indirect FM and direct FM. Demodulation of FM waves, Pre-emphasis and De-emphasis in FM, Numericals	

Unit – III	**Contact Hours = 8 Hours**
Sampling Theory: Low pass sampling, Quadrature sampling, Natural and Flat top sampling, Signal Reconstruction, Practical Aspects of Sampling and Signal Recovery, Sample and Hold Circuit, Pulse Amplitude Modulation, Pulse width Modulation, Numerical	

Unit – IV	**Contact Hours = 8 Hours**
Digital Coding of Analog Signals: Review of Sampling theory, Pulse Code Modulation, Quantization noise and SNR, Robust Quantization, DPCM, Delta Modulation, Adaptive Delta Modulation, Numerical	

Unit – V	Contact Hours = 8 Hours
Measurement of Information: Average information content (entropy) of symbols in long independent sequences, Information rate, Properties of entropy, Joint Entropy, Introduction to Discrete memoryless Communication Channels. **Source Encoding:** Shannon Fano Encoding Algorithm, Huffman's coding algorithm	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	Central limit theorem (2)	FM Radio, TDM (2)	Sampling theorem in frequency-time domain and its applications (2)	DPCM for the transmission of television signals (2)	Properties of codes Frequency Modulation for 5G networks (Case study) (2)

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	2	Generation of narrow band FM and Spectrum analysis Spectrum analysis of pre-emphasis and de-emphasis
2	2	Determining mean and variance of noise of communication channel and its spectrum analysis Determining PDF and CDF of noise
3	2	Generation of Natural and Flat top samples Generation of Pulse amplitude modulated waves
4	2	Analysis of Pulse code modulation Analysis of Delta modulation and Adaptive delta modulation
5	2	Analysis of entropy of source Determining efficiency of source encoding using Shannon Fano/Huffman coding

Unit No.	Self-Study Topics
1	FM stereo multiplexing, Phase-locked loop, FM threshold effect
2	Properties of Gaussian process and Matched filter
3	Pulse Position Modulation
5	Shannon binary encoding algorithm

Books	
	Text Books:

1.	George Kennedy, Bernard Davis, SRM Prasanna “Electronics Communication Systems”,5th edition, McGraw Hill Education (India) Pvt. Ltd
2.	Simon Haykin, “Digital Communications”, John Wiley, 2005 and onwards.
	Reference Books:
1.	B. Sklar, “Digital Communication Fundamentals and Applications”, 2nd Edition, Pearson Education, 2009 and onwards.
2.	B. P. Lathi, “Modern Digital and Analog Communication Systems” 3rd Edition, Oxford University Press 2007 and onwards.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Digital Communication, IIT Bombay, Prof. Bikash Kumar Dey https://nptel.ac.in/courses/117101051/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to(Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the generation and modulation techniques of continuous wave and digital signal	Un	1,2,12	1
2.	**Analyze** the techniques involved in noise analysis and study different compression, waveform coding techniques	An	1,2,12	1
3.	**Analyze** communication channel and **evaluate** information content in different channels	Ev	1,2, 7	2

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks				

2. Calculations, results, graph, conclusion and Outcome: 5 marks
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓										✓	✓		
2	✓	✓										✓	✓		
3	✓	✓					✓						✓		

CONTROL SYSTEMS

Course Code	**22EC43**	Course type	**IPCC**	Credits L-T-P	**3 – 0 – 1**
Hours/week: L - T- P	**3 – 0 – 2**			Total credits	**4**
Total Contact Hours	**L = 40 Hrs; T = 0 Hrs; P = 20 Hrs** **Total = 60 Hrs**			CIE Marks	**100**
Flipped Classes content	**04 Hours**			SEE Marks	**100**

Course Learning Objectives	
1.	To study the Basic concepts, classification and comparison of various types of control systems.
2.	To analyze the stability of system using different criteria's.
3.	To study and Understanding the design fundamentals and applications of modern controllers.

Required Knowledge: **Applied Mathematics and Signals and Systems(22EC33)**

Unit – I Basics of Control Systems and Transfer Function Determination	**Contact Hours = 8**
Open loop and closed loop feedback control systems (analog type), block diagram digital control system, feed-forward control system, transfer function determination of physical systems, block reduction technique, Mason's gain formula, and signal flow graph methods.	

Unit – II Control system Analysis using State Variable Methods	**Contact Hours = 8**
State variable models of electrical and mechanical systems, system equation, transfer function and realization of system from state variable model, state transition matrix and its properties, solution of homogeneous and non-homogeneous systems, concepts of controllability & observability for LTI system.	

Unit – III Stability Analysis of LTI Systems	**Contact Hours = 8**
Pole position-based system stability analysis in Laplace domain using Routh – Hurwitz criterion, Root Locus plot and Bode plot-based analysis of system stability.	

Unit – IV Controller Principles	**Contact Hours = 8**
Classical Controllers – Process characteristics and control parameters, on-off, proportional and PID controllers, PID controller tuning methods. **Modern Controllers** – Adaptive controllers, model predictive controllers, robust controller.	

Unit – V Digital& Computer Based Control of Processes	**Contact Hours = 8**
Digital computer-controlled system application, computer-based controlling of multiple process loops, advantages and implementation problems in digital control,	

S plane to Z plane mapping, data logger and supervisory control, control system networks, Field bus fundamental and operation.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	--	--	--	2 Hours	2 Hours

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
I	3	Time domain (Step response) analysis of second order system under various damping conditions.
I		SIMULINK based modeling of LTI systems. Determination of system transfer function and system response for various standard input signals.
I		Computation of error coefficients and steady state errors for Type 0, Type I, Type II, and Type III systems with Step, Ramp and Parabolic inputs.
II	1	State variable model for cruise control & determination of system response.
III	3	Root Locus based analysis of system stability. (check for various cases)
III		Bode plot based system stability analysis. Determination of Gain margin and phase margin. (check for various cases)
III		Polar plot based system stability analysis (check for various cases)
IV	2	Design and performance analysis of On-Off and Proportional controller.
IV		Controlling of system performance by tuned PID controller.
V	1	Study of different industrial bus and protocols for networked control.

Books	
	Text Books:
1.	M Gopal, "Control Systems: Principles and Design,"McGraw Hill Edu, 2nd Edition.
2.	Katsuhiko Ogata, "Modern Control Engineering," Pearson Education Asia/PHI, 4th Edition, 2002.
3.	Curtis D. Johnson, "Process Control Instrumentation Technology," Person New International Publications, 8th Edition.
4.	Richard C. Dorf and Robert H. Bishop, "Modern Control Systems," Pearson International, 11th Edition.
	Reference Books:
1.	I. J. Nagarath& M. Gopal, "Control Systems Engineering," New Age International Publications, 5th Edition, 2005.
2.	Schaum's Outline Series, "Feedback and Control Systems," McGraw Hill Inc.

	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc19_de04/preview

	Introduction to Control Systems - A Course by Prof. C. S. Shankar Ram, IIT Madras
2.	https://www.youtube.com/watch?v=39Ggoj2fQ2c Introduction to System and Control – A Course by Prof. Ramkrishna Pasumarthy, IIT Madras

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)& Lab Project
3.	Flipped Classes	3.	MATLAB On Ramp Course Certifications
4.	Practice session/Demonstrations in Labs	4.	Lab Test
5.	Virtual Labs	5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Understand and analyze the control systems and study thecontrolling techniques of digital computer-based applications.**	**Un**	1,2,3,5,12	1
2.	**Analyze the stability of control systems.**	**An**	1,2,3,5,9,10	1
3.	**Design and Analysis of controller-based models.**	**An**	1,2,3,4,5,9,10,12	2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks				
Eligibility for SEE:				

1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE**
2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.**
3. Lab test is COMPULSORY
4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.**
5. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓		✓							✓	✓		
2	✓	✓	✓		✓				✓	✓			✓		
3	✓	✓	✓	✓	✓				✓	✓		✓		✓	✓
4															
5															
6															
Tick mark✓ the CO, PO and PSO mapping															

	Skill & competence enhanced after undergoing the course	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	**a. MATLAB & SIMULINK** **b. Design of controller based models** **c. Stability Analysis Techniques**	**Robotics & Automation company**	**Control Engineer, Design & Manufacture Engineer**

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

BIOLOGY FOR ENGINEERS

Course Code	**22EC46**	**Course type**	BSC	**Credits L – T – P**	3 – 0 – 0
Hours/week: L – T – P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	-			**SEE Marks**	100

Course learning objectives	
1.	To familiarize the students with the basic biological concepts and their engineering applications.
2.	To enable the students with an understanding of biodesign principles to create novel devices and structures
3.	To provide the students with an appreciation of how biological systems can be re-designed as substitute products for natural systems
4.	To motivate the students develop the interdisciplinary vision of biological engineering

Module-1	**Contact Hours = 8 Hours**
INTRODUCTION TO BIOLOGY: The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones	

Module-2	**Contact Hours = 8 Hours**
BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).	

Module-3	**Contact Hours = 8 Hours**
HUMAN ORGAN SYSTEMS AND BIO DESIGNS (QUALITATIVE): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems).	

Module-4	**Contact Hours = 8 Hours**
NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin	

(Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs)

Module-5	Contact Hours = 8 Hours
TRENDS IN BIOENGINEERING (QUALITATIVE): Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self- healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).	

Books	
Text Books:	
1.	Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2.	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
3.	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
4.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5.	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011
6.	Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014
7.	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
8.	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
9.	Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019
10.	3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016
11.	Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
E-resources (NPTEL/SWAYAM.. Any Other)- mention links	
1	https://nptel.ac.in/courses/121106008
2	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
3	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
4	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
5	https://www.coursera.org/courses?query=biology
6	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
7	https://www.classcentral.com/subject/biology
8	https://www.futurelearn.com/courses/biology-basic-concepts

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)

3.		3.	Open Assignment/Poster presentation
4.		4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Elucidate the basic biological concepts via relevant industrial applications and case studies.	Un	1	
2.	Evaluate the principles of design and development, for exploring novel bioengineering projects.	Un	1	
3.	Corroborate the concepts of biomimetics for specific requirements.	Un	1	
4.	Think critically towards exploring innovative biobased solutions for socially relevant problems	Ap	1, 7	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓														

2	✓														
3	✓														
4	✓						✓								
Tick mark the CO, PO and PSO mapping															

UNIVERSAL HUMAN VALUES

Course Code	22EC47	Course type	UHV	Credits L-T-P	1 – 0 – 0
Hours/week: L - T- P	1– 0 – 0			Total credits	1
Total Contact Hours	L = 16 Hrs; T = 0 Hrs; P = 0 Hrs Total = 16 Hrs			CIE Marks	50
				SEE Marks	50

Course objectives

1. To provide understanding of basic human values
2. To communicate the need of education for quality life

Knowledge required: English Language, Social Studies

Unit – I Human Values	8 Hours
Objectives, Morals , Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality, Yoga for Professional Excellence and Stress Management.	

Unit – II Value Education	8 Hours
Introduction, Understanding Value Education, Basic Guidelines for Value Education, The content of Value Education, Education for Fulfilling Life, Skill Education, Priority of Values over Skills. The Process of Value Education.	

Activities include - Illustrative case studies and Surveys related to Human values.

	Books
1.	Nagarazan R.S., Professional Ethics and Human Values, New Age International Publishers Pvt.Ltd. 2006
2	P.R.Gaur, R.Sangal, G.P.Bagaria: A Foundation Course in Human Values and Professional ethics.

Course delivery methods		Assessment methods	
1.	Lecture	1.	IA. test
2.	Presentation	2.	Activity
3.	Expert talks	3.	Quiz
		4.	SEE

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and practice the human values	Un	6	
2.	Understand the human values, work ethics, respect others and stress management.	Un, Ap	8	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Quiz	Activities (Case study & Survey)	Total Marks
Marks	15+15 = 30	10	10	50
Minimum score to be eligible for SEE: 20 OUT OF 50				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 1 hour duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	The pattern of the **question paper is MCQ** (multiplechoice questions).

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓									
2								✓							
Tick mark the CO, PO and PSO mapping															