School of Engineering and Applied Sciences

B. Tech Electrical and Electronics Engineering

AY: 2019-2023

Syllabus

Department of Electrical and Electronics Engineering
SRM University- Andhra Pradesh.

Semester-I					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EGL 111 EGL 112	Communicative English **(Non-Minerva)** Communicative English **(Minerva)**	3	0	0	3
PHY 112	Introduction to Classical Mechanics	2	0	0	2
PHY 112 L	Introduction to Classical Mechanics Lab	0	0	2	1
ENG 111	Basic Electronics	3	0	0	3
ENG 111 L	Basic Electronics Lab	0	0	2	1
MAT 112	Single Variable Calculus	3	0	0	3
CSE 101 CSE 101 L CSE 102	Introduction to Programming using python **(Non-Minerva)** Introduction to Programming using python Lab **(Non-Minerva)** Introduction to Programming using python **(Minerva)**	3 0 3	0 0 0	0 2 2	3 1 4
CDC 101	Soft Skills	1	0	0	1
	TOTAL	**15**	**0**	**6**	**18**

Semester-II					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 102	Fundamentals of Electrical Engineering	2	1	0	3
PHY 113	Field Theory-**BS Elective**	2	0	2	3
PHY 221	Electricity and Magnetism	2	0	0	2
PHY 221 L	Electricity and Magnetism Lab	0	0	2	1
ECO 121	Principles of Economics	3	0	0	3
MAT 115	Statistics	3	0	0	3
EGL 121	Critical Thinking	3	0	0	3
MAT 121	Multi Variable Calculus	3	0	0	3
CDC 102	Soft Skills- II	1	0	0	1
	TOTAL	**19**	**1**	**4**	**22**

Semester-III					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 201	Electrical and Electronics Measurement	3	0	0	3
EEE 201 L	Electrical and Electronics Measurement Lab	0	0	2	1
EEE 202	Electrical Circuit Theory	2	1	0	3
EEE 202 L	Electrical Circuit Theory Lab	0	0	2	1
MAT 131	Differential Equations	3	0	0	3
ECE 212	**Open Elective** Signals and systems	3	0	0	3
ECE 212 L	**Open Elective** Signals and systems Lab	0	0	2	1
ECE 211	**Open Elective** Digital Electronics	3	0	0	3
ECE 211 L	**Open Elective** Digital Electronics Lab	0	0	2	1
ENG 101	Fundamentals of Mechanical Engineering	3	0	0	3
CDC 221	Aptitude	1	1	0	1
CSE 230	Industry Standard coding practice 1	0	0	4	1
	TOTAL	**19**	**1**	**12**	**24**

Semester-IV					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 203	Control Systems	3	0	0	3
EEE 203 L	Control Systems Lab	0	0	2	1
EEE 205 P	UROP	0	0	6	3
EEE 204	DC machines and Transformers	3	0	0	3
EEE 204 L	DC machines and Transformers Lab	0	0	2	1
ECE 221	**Open Elective** Analog Electronics	3	0	0	3
ECE 221L	**Open Elective** Analog Electronics Lab	0	0	2	1
MAT 211	Linear Algebra	3	0	0	3
ENG 105 L	SolidWorks (Engineering Graphics)	0	0	2	1
ISES 212	Industry Specific Employability Skills IV	1	1	0	1
CSE 330	Industry Standard Coding Practice-2	0	0	4	1

	TOTAL	**13**	**1**	**18**	**21**

Semester-V					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 301	AC Machines	3	0	0	3
EEE 301 L	AC Machines Lab	0	0	2	1
EEE 308	Power Electronics	3	0	0	3
EEE 308 L	Power Electronics Lab	0	0	2	1
EEE 304	Fundamentals of Power Systems	3	0	0	3
EEE 305	Advanced Control Systems	3	0	0	3
EEE 305 L	Advanced Control Systems Lab	0	0	2	1
	Open Elective Power Plant Engineering FPGA Programming Object Oriented programming using C EM theory and wave propagation Digital Signal Processing	3	0	0	3
EEE 302	**Technical Elective** Numerical Methods	3	0	0	3
ISES 311	Industry Specific Employability Skills-V	1	1	0	0
CSE 331	Industry Standard Coding Practice - 3	0	0	4	1
	TOTAL	**18**	**1**	**10**	**22**

Semester-VI					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 306	Power System Analysis	3	0	0	3
EEE 306 L	Power System Analysis Lab	0	0	2	1
EEE 309	Synchronous Machines	3	0	0	3
EEE 309 L	Synchronous Machines Lab	0	0	2	1
EEE 310 P	Multi-Disciplinary Design Project	0	0	6	3
ECE 313	**Open Elective** Microprocessors and Interfacing	3	0	0	3
ECE 313 L	**Open Elective** Microprocessors and Interfacing Lab	0	0	2	1
EEE 314	**Open Elective** Nuclear Power Generation	3	0	0	3
EEE 311	**Technical Elective** Non-Linear Systems & Control	3	0	0	3

EEE 312	Renewable Energy Systems				
ENV 111	Environmental Science	2	0	0	2
ENV 111 L	Environmental Science Lab	0	0	2	1
ISES 312	Industry Specific Employability Skills-VI	1	1	0	0
	TOTAL	**17**	**1**	**14**	**24**

Semester-VII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 403	Switch Gear and Protection	3	0	0	3
EEE 403 L	Switch Gear and Protection Lab	0	0	2	1
EEE 404	High Voltage Engineering	3	0	0	3
EEE 404 L	High Voltage Engineering Lab	0	0	2	1
	Open Elective Embedded systems VLSI Microwave Theory and Applications 3D Printing	3	0	0	3
	Technical Elective Electrical Machine Design HVDC System Modeling and Identification Power Quality	3	0	0	3
	Technical Elective Computer Techniques in Power Systems	3	0	0	3
	Technical Elective Pulsed Power systems Flexible AC transmission system Non-Linear Control System Utilization of Electric power Advanced Power Electronics Resonant & Soft Switching Converters E-Mobility	3	0	0	3
	TOTAL	**18**	**0**	**4**	**20**

Semester-VIII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 410 P	Project	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

SYMBOLS AND ABBREVIATIONS

1. EGL – English
2. CDIO – Conceive Design Implement Operate
3. EEE – Electrical & Electronics Engineering
4. ACM - Association for Computing Machinery
5. L-T-P-C -- L- Lecture Hours Per Week
   T- Tutorial Hours Per Week
   P- Practical Hours Per Week
   C- Credits for a Course
6. SB – Skill Building
7. CLA – Class Learning Assessment
8. OE - Open Electives

Humanity/Social Science Electives

Foreign languages
Historical thinking
Political Science
Music
Theatre
Soft Skills
Aptitude/Reasoning Skills
CDC

SEMESTER- I

EGL 111	Communicative English	L	T	P	C
		3	0	0	3
Co-requisite:	Must be able to Communicate in English Language using all four skills (L, S, R, and W) and must possess basic knowledge of English Grammar rules (S+V+O).				
Prerequisite:	Must have basic knowledge of how to use MS Office (Word & Power Point).				
Data Book / Codes/Standards	NIL				
Course Category	Humanity Sciences.				
Course designed by	Department of English.				
Approval					

PURPOSE	To expose the learners to different forms of 'Communication in English Language' (Written, Oral and Presentation skills).				
LEARNING OBJECTIVES		**STUDENT OUTCOMES**			
At the end of the course, student will be able to					
a.	Understand and apply the Fundamentals of Communication while producing the Language in specific contexts (Academic, Professional & Social).	C	D	I	O
b.	Use all four skills to express themselves using production skills (Speak and Write) and will be able to present their views using Power Point and Word.	C	D	I	O

INSTRUCTIONAL OBJECTIVES

1. To Introduce the Principles and Practices of Effective Communication Skills in various contexts.
2. To help the participants understand the purpose and differentiate various types of audience.
3. To encourage participants to self-evaluate while collaborating with peers during learning.
4. To prepare the students to produce Language in various contexts be it Oral or Written form.

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**9**			
1.	ɔurse Introduction & Departmental Policies.	2	C		0
2.	Capitalization & Punctuations.	2	C, D, I	1	1,2
3.	Prefixes, Suffixes & Tenses.	2	C, D, I	1	1,2
4.	Etymology & Parts of Speech.	2	C, D, I	1	1,2
5.	Principles of Sentence Structure & Paragraph Writing (*S+V+O*).	1	C, D, I	1	1,2
	UNIT-II	**9**			
6.	The Fundamentals of Speech (*Ethos, Pathos & Logos*).	3	C, I, O	1, 2	1,2

7.	How to give a good Speech? (*Rhetoric & Speech Delivery*).	2	C, D, I	1, 2	1,2
8.	Verbal & Nonverbal Communication.	2	C, D, O	2	1,2
9.	Fundamentals of Personal, Informative & Scientific Speech.	2	C, O	1, 2	1,2
	UNIT-III	**9**			
10.	Differences between Listening & Hearing.	2	D, O	2	1,2
11.	Listening to Influence, Negotiate.	2	D, O	2, 3	1,2
12.	Listening to Specific Information.	3	D, O	2, 3	1,2
13.	Note taking & Making while Listening.	2	C, D, O	2, 3	1,2
	UNIT-IV	**9**			
14.	Read to Skim, Scan & Annotate.	2	D	2, 4	1,2
15.	Read to Comprehend. (Predict, Answer Questions & Summarize)	3	D	2, 4	1,2
16.	Read to Appreciate & to Compose.	3	D, O	2, 3, 4	1,2
17.	Read to Understand Referencing Skills for Academic Report Writing (APA 6th Ed).	3	O	4	1,2,3
	UNIT –V	**9**			
18.	Write to Interpret Data (Flow charts, Bar Diagrams).	2	C, D, I	4	1, 2, 4,
19.	Write to Inform (News, Emails, Notice, Agenda & Minutes)	2	C, D, O	3, 4	1, 2,
20.	Write to Define (Definitions & Essays).	2	D, O	4	1,2
21.	Write a Review (Short Story or Poem & the Course).	3	D, O	3, 4	1,2,4
22.	Write Academic Abstract Proposal (Science & Technology).	4	D, O	3, 4	1,2
23.	Introduction to APA 6th Ed.	3	D, I, O	4	3
	Total Contact Hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Shoba, Lourdes. (2017). Communicative English: A Workbook. U.K: Cambridge University Press.
2.	Steven, Susan, Diana. (2015). Communication: Principles for a Life Time. U.S.A: Pearson 6th Ed.

3.	Publication Manual of the American Psychological Association, (2010). 6th Ed.
4.	Kosslyn, S.M. "Understanding Charts and Graphs", *Applied Cognitive Psychology*, vol. 3, pp. 185-226, 1989.

Course nature:				**Theory**		
Assessment Method (Weightage 100%)						**Total**
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA 1	CLA 2	
	Weightage	**15%**	**15%**	**15%**	**15%**	**60%**
End semester examination Weightage : 40%						**40%**

PHY 112	**Introduction to Classical Mechanics**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL
Course Category	Basic Sciences
Course designed by	Department of Physics
Approval	

PURPOSE	The course aims to cover the fundamental formalism and applications of classical mechanics. It mainly includes basic Newtonian mechanics and special theory of relativity. After this course, the students will be able to apply the fundamental concepts of mechanics such as force, energy, momentum etc. more rigorously as needed for further studies in engineering and technology. This course will help the students' physical intuition and thinking process through understanding the theory and in turn they will be able to model simple mechanical systems by correlating it to the real world practical problems.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply the fundamental concepts of Newtonian mechanics such as force, energy, momentum, and energy conservations							
2.	Develop their physical intuition and thinking process to model electromechanical systems							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I REVIEW OF NEWTONIAN MECHANICS	**6**	C, D	I	1, 2
1.	Review of Scalars, Vectors and Kinematics, Newton's Laws of Motion and applications,	2	C, D	I	1, 2
2.	Contact Forces, Static Friction, worked examples	2	C, D	I	1, 2
3.	Tension and springs, Pushing Pulling and Tension, Solving Pulley Systems.	2	C, D	I	1, 2
	UNIT-II CIRCULAR MOTION	**6**			
4.	Coordinates, Position and Velocity Vectors, Angular Velocity.	2	C, D	I	1, 2
5.	Uniform Circular Motion, Direction of the Acceleration,.	2	C, D	I	1, 3
6.	Period and Frequency, Angular Acceleration, Newton's Second. law and circular motion, worked examples.	2	C, D	I	1, 3
	UNIT- III MOMENTUM AND IMPULSE	**6**			
7.	Momentum and Impulse, Impulse momentum theorem, Conservation of Momentum,	2	C, D	I	1, 2

	Momentum Diagrams, worked examples.				
8.	Center of Mass and Motion of the Center of Mass, Center of Mass of a Continuous System - Center of Mass of a Uniform Rod and different objects.	2	C, D	I	1, 4
9.	Velocity and Acceleration of the Center of Mass, Reduction of a System to a Point Particle, Center of Mass Trajectory.	2	C, D	I	1, 2
	UNIT-IV WORK, ENERGY AND COLLISION	**6**			
10.	Kinetic Energy and Work in 1D and 2D, Work by a constant Force's	1	C, D	I	1, 4
11.	Work by a Non- Constant Force, Work-Kinetic Energy Theorem and related problems, Worked Examples.	2	C, D	I	1, 2
12.	Conservative and Non-Conservative Forces, Potential Energy due to gravity and of a spring, worked examples, Principle of energy conservation and worked examples.	2	C, D	I	1, 5
13.	Collision and its type, Collision in 1D and worked examples, Collision in 2D and worked examples.	1	C, D	I	1, 2
	UNIT – V RELATIONAL MOTIONS, GRAVITATION	**6**			
14.	Rotational Motion, Motion of a rigid body and moment of inertia, Parallel and perpendicular axis theorem.	2	C, D	I	1, 5
15.	Moment of inertia of different objects, Torque and Angular momentum, worked examples.	1	C, D	I	1, 5
16.	Conservation of angular momentum, Rolling motions – conservation of energy. Central forces, Newton's Law of Gravitation, Acceleration due to gravity, Gravitational Potential Energy.	3	C, D	I	1, 4
	Total contact hours	**30**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Conservation of angular momentum, Rolling motions – conservation of energy. Central forces, Newton's Law of Gravitation, Acceleration due to gravity, Gravitational Potential Energy.
2.	Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited)
3.	Classical Mechanics (2011) - Herbert Goldstein (Publisher – Pearson Education).
4.	Classical Mechanics (2014) - J. C Upadhayaya (Publisher – Himalaya Publishing House)

5.	Fundamentals of Physics – Resnick and Halliday (Publisher – Wiley)

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50 %						**50%**

PHY 112 L	**Introduction to Classical Mechanics Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL
Course Category	Basic Sciences
Course designed by	Department of Physics
Approval	

PURPOSE	The course aims to cover the fundamental formalism and applications of classical mechanics. It mainly includes basic Newtonian mechanics and special theory of relativity. After this course, the students will be able to apply the fundamental concepts of mechanics such as force, energy, momentum etc. more rigorously as needed for further studies in engineering and technology. This course will help the students' physical intuition and thinking process through understanding the theory and in turn they will be able to model simple mechanical systems by correlating it to the real world practical problems.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply the fundamental concepts of Newtonian mechanics such as force, energy, momentum, and energy conservations							
2.	Develop their physical intuition and thinking process to model electromechanical systems							

Sl. No	Experiment name	Objectives
1.	Experimental data analysis	Computation methods of data analysis with MS-Excel and Python program and Graphs plotting
2.	Error Analysis	Different statistical methods for Experimental data analysis
3.	Revisions of Vernier caliper	a) Determination of least counts of Vernier calliper b) Determination of length, width and thickness of a metal rod and sheets
4.	Revisions of Screw Gauge	a) Determination of least counts millimeter Screw Gauge instruments b) Determination of radius of a given metal wire
5.	Determination of Young's modulus of the material	To calculate the Young's modulus of a given material by deflection method
6.	Determination of rigidity modulus of the material - torsional pendulum	To determine the rigidity modulus of the material of the wire by torsional oscillations
7.	Determine moment of inertia of a flywheel	To determine the moment of inertia of a flywheel
8.	Determination of spring constant	To determine spring contact for a given spring and verify the Hooke's law
9.	Compound Pendulum	a) Measure the time period for a given compound pendulum with various lengths b) Determine radius of gyration of a given pendulum
10.	Determination of velocity of Sound in a medium	To determine velocity of sound in air or quantitative experiments on resonating columns
11.	Determination of thermal conductivity of a given material	To study the thermal conductivity of a given material in a constant temperature gradient
12.	Measurement of specific heat capacity of any given material	Determine the specific heat capacity of a given material by heat exchange method

13.	Verification of Stefan`s Law	To verify the power radiated by a body is proportional to the 4^{th}power of the absolute temperature.
14.	Determination of Joule's Constant	To determine Joule's constant (J) by electric method

Course nature				**Practical**	
Assessment Method – Practical Component (Weightage 100%)					
In-semester	**Assessment tool**	Lab performance	Practical model exam	Observation note	**Total**
	Weightage	**20%**	**20%**	**10%**	**50%**
End semester examination Weightage: 50%					**50%**

ENG 111	**Basic Electronics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL
Course Category	Engineering Sciences
Course designed by	Department of Electronics and Communication Engineering.
Approval	

PURPOSE	The course aims at introducing the Basic Electronic Device and Circuit concepts for all first year Engineering students. Students will get an understanding and appreciation of fundamental concepts, analyzing and designing simple Electronic Circuits for practical applications with devices such as Diodes, BJT, MOSFETs, etc.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Will get thorough understanding of fundamental concepts behind operation of basic Electronic devices and circuits in day to day applications.	a	e					
2.	Analyze and design simple circuits with basic electronic devices.	a						
3.	Will have hands on analyzing and designing simple electronic circuits.	a	c					
4.	Will have a project based learning through a course project as part of the evaluation and can learn to make a PCB.	c						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Basic Electronic Circuit Concepts	**9**			
1.	Introduction to Units, Scales, Charge, Current, Voltage, Power.	1	C	1	1
2.	Voltage and Current Sources, Dependent and Independent Sources.	1	C	1	1
3.	Ohm's Law, Resistance, Conductance, Resistivity, Conductivity.	1	C	1	1
4.	Introduction to Nodes, paths, Branches, Loop and KCL, Numerical.	1	C,D	1,2	1
5.	KVL, Single Loop and node pair circuits analysis.	1	C	1,2	1
6.	Series and Parallel connected sources, Resistors in series, parallel.	1	C	1	1
7.	Voltage and Current Division, Numerical.	1	C	1	1
8.	Thevenin Equivalent Circuits.	1	C	1	1
9.	Norton Equivalent Circuits.	1	C	1	1
	UNIT II – Semiconductor Basics and Diode Models	**9**			
10.	Introduction to Semiconductors- Si, Ge, GaAs, Covalent bonding and Intrinsic Semiconductors, Difference in band Diagrams of Insulators,	1	C	1	2

	conductors, Semiconductors.				
11.	Doped Semiconductor, n-type and p-type.	1	C	1	2
12.	Current mechanisms in Semiconductor-Drift and Diffusion with expressions, Resistivity of a semiconductor, Numerical.	1	C	1,2	2
13.	PN Junction Diode Operation under No Bias, Forward bias, Reverse Bias conditions, I-V characteristics.	1	C	1,2	2
14.	Reverse Breakdown, Effect of Temperature on Diode characteristics.	1	C	1,2	2
15.	I-V Characteristics of Ideal vs Practical diodes, Diode Resistance levels.	1	C	1,2	2
16.	Diode Equivalent circuits- Piecewise, Simplified and Ideal Diode models and I-V Characteristics.	1	C	1,2	2
17.	Diode Capacitances and Reverse recovery time.	1	C	1,2	2
18.	Zener Diode operation.	1	C	2,3	2
	UNIT III–Diode Applications	**9**			
19.	Load line Analysis, Series and Parallel Diode Configurations and analysis of circuits with application of KCL, KVL, etc.	1	C	2,3,4	2
20.	Diode based AND/OR Logic gates design and analysis.	1	C	2,3,4	2
21.	Half wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor with a filter circuit, PIV.	1	C	2,3,4	2
22.	Bridge Full wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor, PIV.	1	C	2,3,4	2
23.	CT Full wave Rectifier Operation; Circuit, waveforms, DC output, Peak output, Ripple factor with a filter circuit, PIV.	1	C	2,3,4	2
24.	Analysis and Design with Series and Parallel configuration of Clipper circuits.	1	C	2,3,4	2
25.	Analysis and Design with Series and Parallel configuration of Clipper circuits.	1	C	2,3,4	2
26.	Clamper Circuits and analysis with DC sources.	1	C	2,3,4	2
27.	Zener Diode as Voltage Regulator circuit.	1	C	2,3,4	2
	UNIT IV: BJT and MOSFETs	**9**			
28.	BJT structure and Physical operation.	1	C	1,2	3
29.	Large signal models and Operation in Saturation.	1	C	1,2	3
30.	BJT Current-Voltage characteristics and Graphical Representation.	1	C	2,3	3

31.	Early effect and model. Analysis of BJT circuits at DC.	1	C	1,2	3
32.	MOSFET structure and operation.	1	C	2,3	3
33.	P-MOSFET and CMOS introduction.	1	C	1,2,3	3
34.	MOSFET I-V Characteristics, Large signal model.	1	C	1,2,3	3
35.	Channel Length modulation and Characteristics, Model.	1	C	1,2	3
36.	Analysis of MOSFET circuits at DC.	1	C	1,2	3
	UNIT V: Single Stage Transistor Amplifiers	**9**			
37.	Basic Principles of Amplification: BJT vs MOSFET.	1	C	1,2,3	3
38.	Basic Principles of Amplification: BJT vs MOSFET.	1	C	1,2,3	3
39.	BJT and MOSFET small signal operation and models.	1	C	1,2,3	3
40.	BJT and MOSFET small signal operation and models.	1	C	1,2,3	3
41.	BJT and MOSFET basic configurations, characterizing amplifiers.	1	C	1,2,3	3
42.	Analysis of CS and CE Amplifiers.	1	C	1,2,3	3
43.	Analysis of CS (CE) Amplifiers with source (Emitter) Resistance.	1	C	1,2,3	3
44.	Analysis of CG and CB Amplifiers. Analysis of Source and Emitter followers.	1	C	1,2,3	3
45.	BJT and MOSFET biasing arrangements.	1	C	1,2,3	3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Engineering Circuit Analysis, by William Hayt, J E Kemmerly and S.M. Durbin, 8th Edition, Mc Graw Hill.
2.	"Electronic Devices and Circuit Theory" by R L Boylestad, L Nashelsky, 11th edition.
3.	"Microelectronic Circuits Theory and Applications", by Sedra and Smith, 7th Edition, Oxford

ENG 111 L	**Basic Electronics Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL
Course Category	Engineering Sciences
Course designed by	Department of Electronics and Communication Engineering.
Approval	

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Verification of KCL, KVL and Ohm's Laws.	1	C	1,2,3.4	1
2.	Analysis of a Given Circuit with Resistors and Sources and Verification.	2	C	1,2,3.4	1
3.	Verification of PN Junction Diode I-V Characteristics in FB and RB Operation.	2	C	1,2,3.4	2
4.	Diode based Rectifier Circuits.	1	C	1,2,3.4	2
5.	Introduction to PCB design.	1	C	1,2,3.4	2
6.	Diode based Clipper and Clamper Circuits.	1	C	1,2,3.4	2
7.	Zener Diode As Voltage Regulator.	1	C	1,2,3.4	2
8.	BJT CE Configuration Input and Output Characteristics.	2	C	1,2,3.4	3
9.	MOSFET CS Configuration Input and Output Characteristics.	2	C	1,2,3.4	3
10.	MOSFET Single stage CS Amplifier Frequency Response.	2	C	1,2,3.4	3
	Total contact hours	**15**			

Course nature				**Theory & Lab**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Quiz's	Assignments	Mid Term-I	Mid Term-II	Course Project	**Total**
	Weightage	**10%**	**10%**	**15%**	**15%**	**15%**	**65%**
End semester examination Weightage: 35%							**35%**

MAT 112	**Single Variable Calculus**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				

Data Book / Codes/Standards	NIL
Course Category	Basic Sciences
Course designed by	Department Of Mathematics
Approval	

PURPOSE	The course aims to cover the standard material in a first course of Calculus such as sequences, series, limits, derivatives, maxima and minima, integration, the fundamental Theorem of Calculus, area under a curve and area between curves.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the concepts of limit, derivative and integral.							
b.	Compute derivatives and integrals of elementary functions of one variable.							
c.	Solve some problems in maxima and minima and use integration to find areas.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – Sequences and Series	**7**			
1.	Sequences, series.	2	C		1,2,3
2.	Sum of a series, Geometric series.	2	C		1,2,3
3.	P-series.	1	C		1,2,3
4.	Comparison test, root test, ratio test.	2	C		1,2,3
	UNIT II – Limits and Continuity	**8**			
5.	Limit of a function at a point, one sided limits.	3	C		1,2,3
6.	Continuity.	3	C		1,2,3
7.	Limits involving infinity.	2	C		1,2,3
	UNIT III – Differentiation	**10**			
8.	Derivative at a point.	2	C		1,2,3
9.	Derivative as a function.	2	C		1,2,3
10.	Product Rule, Quotient Rule.	2	C		1,2,3
11.	Chain Rule, Implicit Differentiation.	2	C		1,2,3

12.	Rolle's Theorem, Mean Value Theorem.	2	C		1,2,3
	UNIT IV: Applications of Derivatives	**11**			
13.	Maxima and minima.	2	C		1,2,3
14.	Monotonic functions and first derivative test.	2	C		1,2,3
15.	Related rates.	1	C		1,2,3
16.	Concavity and curve sketching.	1	C		1,2,3
17.	Optimization problems.	2	C		1,2,3
18.	Newton's Method.	1	C		1,2,3
19.	Taylor and McLaurin Series.	2	C		1,2,3
	UNIT V: Integration	**9**			
20.	Area as a limit of finite sums.	2	C		1,2,3
21.	Definite and indefinite integral.	2	C		1,2,3
22.	Fundamental Theorem of Calculus .	1	C		1,2,3
23.	Integration by substitution and integration by parts.	2	C		1,2,3
24.	Area between curves.	1	C		1,2,3
25.	Arc length.	1	C		1,2,3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Thomas' Calculus, 14th Edition, (2018) – J. Hass, C. Heil, M. Weir, Pearson Education
2.	Introduction to Real Analysis, Fourth Edition (2014) – R. Bartle, D. Sherbert, John Wiley and Sons
3.	Calculus and Analytic Geometry, Ninth Edition (2017) – G. Thomas, R. Finney, Addison Wesley

Course nature	**Theory**
Assessment Method (Weightage 100%)	

In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA 1	CLA 2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50 %**
End semester examination Weightage : 50%						**50 %**

CSE 101	**Introduction to Programming using Python**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Co-requisite:	NIL
Prerequisite:	NIL
Data Book / Codes/Standards	NIL
Course Category	Engineering Science
Course designed by	Department of CSE
Approval	

PURPOSE	The course is designed to get the basic knowledge in Python. Decision making and functions in python. Helps to learn File handling and basics OOPs concept in python.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**
At the end of the course, student will be able to		
1.	Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.	
2.	Express different Decision-Making statements and Functions.	
3.	Interpret object-oriented programming in Python.	
4.	Understand and summarize different File handling operations.	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Python	**9**			
1.	Knowledge, Machines, Languages.	1			1
2.	Types, Variables Operators and Branching.	1			1
3.	Core elements of programs: Bindings, Strings, Input/Output, IDEs.	1			1
4.	Input/Output, IDEs.	1			1
5.	Control Flow, Iteration, Guess and Check.	1			1
6.	**Simple Programs**: Approximate Solutions.	1			1
7.	Bisection Search.	1			1
8.	Floats and Fractions.	1			1
9.	Newton-Raphson.	1			1
	Unit II : Functions	**9**			
10.	Decomposition and Abstraction.	1			1
11.	Functions and Scope.	1			1,2

12.	Keyword Arguments, Specification.	1			1,2
13.	Iteration vs Recursion.	1			1,2
14.	Inductive Reasoning.	1			1
15.	Towers of Hanoi.	1			1,2
16.	Fibonacci.	1			
17.	Recursion on non – Numerics.	1			
18.	Files.	1			
	UNIT III: Tuples and Lists	**9**			
19.	**Tuples and Lists**: Tuples, Lists, List Operations.	1			1
20.	Mutation, Aliasing, Cloning.	1			1
21.	**Dictionaries**: Functions as Objects, Dictionaries.	1			1
22.	Example with a Dictionary, Fibonacci, and Dictionaries.	1			1
23.	Global Variables.	1			1
24.	**Debugging**: Programming Challenges.	1			
25.	Classes of Tests, Bugs, Debugging, Debugging Examples.	1			1
26.	**Assertions and Exceptions,** Assertions, Exceptions.	1			
27.	Exception Examples.	1			
	UNIT IV: Classes and Inheritance	**9**			
28.	Object Oriented Programming.	1			4
29.	Class Instances, Methods Classes Examples.	1			4
30.	Why OOP, Hierarchies.	1			4
31.	Your Own Types – **An Extended Example**: Building a Class.	1			4
32.	Visualizing the Hierarchy.	1			4
33.	Adding another Class.	1			
34.	Using Inherited Methods.	1			
35.	Gradebook Example.	1			
36.	Generators.	1			

	UNIT V: Computational Complexity	**9**			
37.	Program Efficiency.	1			2
38.	Big Oh Notation.	1			2,4
39.	Complexity Classes, analyzing Complexity	1			2
40.	**Searching and Sorting Algorithms**: Indirection.	1			2,4
41.	Linear Search.	1			
42.	Bisection Search.	1			
43.	Bogo and Bubble Sort.	1			
44.	Selection Sort.	1			
45.	Merge Sort.	1			
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT).
2.	Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
3.	Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher(2016).

Course nature			**Theory and Lab**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignments	Lab Performance	Quiz	**Total**
	Weightage Theory	**15%**	**15%**	**5%**	**10%**	**5%**	**50%**
End semester examination Weightage : 50%							**50%**

CSE 101 L	**Introduction to Programming using Python Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Science				
Course designed by	Department of CSE				
Approval					

Lab Assignments	
1.	A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2.	Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3.	Write a Python program to find the factorial of the given number (Example : 5!= 5*4*3*2*1 =120)
4.	Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
5.	Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6.	Write a python program for bubble sort algorithm. What is the best case and worst case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7.	Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8.	Write a Program in python using object oriented concept to make calculator which has the following operations: Addition , Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9.	Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10.	Write a Program in python using object oriented concept to create a base class called **Polygon** and there are three derived classes named **as triangle, rectangle** and **square**. The base class consists of the **input function** for accepting sides length and the derived classes must have **output function** for displaying area of triangle, rectangle and square.

CDC 101	**Soft Skills**	**L**	**T**	**P**	**C**
		1	**1**	**0**	**1**

Co-requisite:	NIL
Prerequisite:	NIL
Data Book / Codes/Standards	NIL
Course Category	Skill Building
Course designed by	Department of Career Development Centre
Approval	

PUR-POSE	The most conspicuous perceptual error is the thought that personality is confined to physical appearance alone. Personality is a complete package of an individual's identity; it is in fact a person's reality. The development of one's personality is essential for having an impressive image both in the personal & professional areas to create an electrifying impact and a lasting impression.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
a.	Understanding self-personality style.							
b.	Understanding the three Vs of communication, learn to be an active listener an effective communicator and impactful presenter.							
c.	Learn the art of prioritization and effective time management, setting smart goals, Identifying motivational levels.							
d.	Learn to think out of the box and solve problems accurately. Develop creative thinking. Learn to be innovative. Better understanding of the 5 stages of team building,							
e.	Understanding the difference between critical and lateral thinking and its applications, Identify stress roots and develop coping skills to manage the stress.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I				
1.	Know Thyself.	1			1,7
2.	Personality Development.	1			1,2,7
	UNIT 2				
3.	Communication Skills.	1			1,3,7
4.	Presentation Skills	1			1,4,7
	UNIT 3				
5.	Time Management.	1			1,7
6.	Goal Settings.	1			1,7
7.	Motivation.	1			1,7
	UNIT 4				
8.	Creativity.	1			1,7
9.	Innovation.	1			1,7
10.	Team Dynamics.	1			1,7

	UNIT 5				
11.	Critical Thinking.	1			1,7, 8
12.	Lateral Thinking.	2			1, 6,7
13.	Stress Management.	2			1,5,7
	Total contact hours	**15**			

LEARNING RESOURCES		
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Soft Skills Training: A Workbook to Develop Skills for Employment. Book by Frederick H. Wentz.	
2.	Personality Development and Soft Skills by Barun Mitra.	
3.	Communication Skills by Sanjay Kumar.	
4.	Presentation Skills for Managers Book by Kerri Garbis..	
5.	The Stress Management by Ruth C. White.	
6.	Lateral thinking: Creativity Step by Step by Edward de Bono.	
7.	Soft Skills Training: A Workbook to Develop Skills for Employment Book by Frederick H. Wentz	
8.	Critical Thinking: Your Guide to Effective Argument, Successful Analysis and Independent Study Book by Tom Chatfield	

Assessment Method – (Weightage 100%)				
In-semester	**Assessment tool**	CLA I	CLA II	**Total**
	Weightage	**50%**	**50%**	**100%**

SEMESTER II

EEE 102	Fundamentals of Electrical Engineering	L	T	P	C
		2	1	0	3

Co-requisite:	NIL
Prerequisite:	Intermediate Level Mathematics and Physics
Data Book / Codes/Standards	NIL
Course Category	Engineering Sciences
Course designed by	Department of Electrical and Electronics Engineering
Approval	

PURPOSE	To provide the basic idea of electrical and magnetic circuit analysis, single and three phase circuits and the operating principle of electrical machines.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the fundamental laws and basic concepts of electrical circuits.							
b.	Gain knowledge on the analysis of electrical circuits using mesh current and node voltage methods.							
c.	To learn the fundamentals of magnetic and electrical circuits.							
d.	Understand the steady-state analysis of RL, RC, and RLC circuits with phasor diagrams and three phase circuits.							
e.	To understand the working principle of electrical machines.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Basic Circuit Analysis	**9**			
1.	Ohm's Law, Kirchhoff's Laws, Concept of Node, Path, Loop, Branch, Mesh.	2	C		1,2
2.	Voltage and Current Division, Ideal and Practical Voltage and Current Source, Dependent Voltage and Current Sources, Source Transformations.	2	C		1,2
3.	Nodal Analysis - Presence of independent and dependent voltage and current sources.	1	C		1,2
4.	The Super node - Presence of independent and dependent voltage and current sources.	1	C		1,2
5.	Mesh Analysis and Super mesh - Presence of independent and dependent voltage and current sources.	1	C		1,2
6.	Illustrative examples.	2	C		1,2
	UNIT II: Electromagnetism and Electrostatics	**9**			
7.	Review of field around a conductor and coil, Magnetic flux and flux density, magneto motive force and magnetic field intensity, reluctance, and permeability.	2	C		1-3
8.	Analysis of magnetic circuit and basic analogy between electric and magnetic circuits.	2	C		1-3
9.	Faraday's law of electromagnetic induction, Fleming's right hand and left-hand rule, Lenz's Law, Statically and dynamically induced EMF.	1	C		1-3
10.	Self-inductance, mutual inductance, and	2	C		1-3

	coefficient of coupling. Inductors in series and parallel, Energy stored in magnetic field.				
11.	Laws of Electrostatics, Electric field, Composite dielectric capacitors, Capacitors in series and parallel.	1	C		1-3
12.	Energy stored in capacitors, Illustrative examples.	1	C		1-3
	UNIT-III: Single-Phase AC circuits	**9**			
13.	Basic Concepts Related to Generation of Sinusoidal AC Voltage.	1	C		1-3
14.	Definition and Numerical values of Average Value, Root Mean Square Value, Form Factor and Peak Factor for sinusoidal varying quantities.	1	C		1-3
15.	Steady State Analysis of Pure R, L, C Circuits.	1	C		1-3
16.	Steady State Analysis of RL and RC Series Circuits with Phasor Diagrams.	1	C		1-3
17.	Steady State Analysis of RL and RC Parallel circuits with Phasor Diagrams.	1	C		1-3
18.	Steady State Analysis of RLC Series and Parallel circuits with Phasor Diagrams.	1	C		1-3
19.	Definitions of Real Power, Reactive Power, Apparent Power and Power Factor.	1	C		1-3
20.	Concepts of Resonance.	1	C		1-3
21.	Illustrative examples.	1	C		1-3
	UNIT IV: Three Phase Circuits	**9**			
22.	Necessity and advantages of three phase systems, generation of three phase power.	2	C		1-3
23.	Definition of Phase sequence, balanced supply, and balanced load. Relationship between line and phase values of balanced star and delta connections.	2	C		1-3
24.	Power in balanced three phase circuits.	1	C		1-3
25.	Measurement of power by two-wattmeter method, Determination of power factor using wattmeter readings.	2	C, D		1-3
26.	Illustrative examples.	2	C		1-3
	UNIT-V: DC Machines & Single-Phase Transformers	**9**			
27.	DC machines: Operation of DC motor, Back EMF, Torque equation.	2	C, D		1-3
28.	Types of DC motors, Series, Shunt, Separately Excited, Characteristics and Applications.	1	C, D		1-3
29.	Significance of back EMF, Illustrative examples.	1	C, D		1-3
30.	Single Phase Transformers: Necessity of transformer.	1	C, D		1-3
31.	Principle of operation and construction of single-phase transformers (core and shell types).	2	C, D		1-3
32.	EMF equation, losses, various losses with respect to load.	2	C, D		1-3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a]	William H Hayt, J E Kemmerly and Steven M Durbin, "*Engineering Circuit Analysis*", McGraw Hill, 8th Edition, 2011.
2[a]	Abhijit Chakrabarti, "*Circuit Theory Analysis and Synthesis*", Dhanpat Rai & Co. 7th Edition, 2017.
3[a]	P S Bimbra, "*Electrical Machinery*", 7th Edition, Khanna Publishers.
4[b]	Charles K. Alexander and Matthew N.O. Sadiku, "*Fundamentals of Electric Circuits*", McGraw Hill Higher Education, Third Edition, 2005.
5[b]	B.L. Theraja and A. K Theraja, "*A Textbook of Electrical Technology*", S.Chand and Co. Ltd., 2000.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

		2	**0**	**2**	**3**
Co-requisite:	NA				
Prerequisite:	Multivariable Calculus (MAT 121)				
Data Book / Codes/Standards	NIL				
Course Category	BS Electives				
Course designed by	Department of Physics				
Approval					

PURPOSE	To learn the basic mathematical tools to understand Electromagnetic field theory to analyze electromagnetic wave propagation in a transmission line To use electromagnetic theory to qualitatively explain in a well-structured and logical concise way numerically obtained results

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Be familiar with and able to use electromagnetic laws and theorems							
2.	Be able to formulate idealized models for electromagnetic problems							
3.	Be able to apply electromagnetic theory to solve problems primarily in physics and electrical engineering							
4.	Be able to explain in a well-structured and logical concise way derivations/relations within electromagnetics as well as between the central concepts of the theory							
5.	Be able to formulate, analyze and solve electrostatic problems with the help of a modern numeric computer tool							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT I-Review of Electromagnetism	**9**	C, D		
1.	Del operator	1	C, D		1
2.	Laplacian of a scalar	1	C		1
3.	Helmholtz's theorem	1	C		1
4.	Capacitor and capacitance	1	C, D		1
5.	Inductor and Inductances	1	C, D		1
6.	Poisson's and Laplace's equation	1	C		2, 3
7.	General procedure for solving Poisson's and Laplace's equation	1	D, I		2, 3
8.	Computer-aided analysis of electromagnetic field propagations	1	D, I,		1
9.	Finite difference and finite element methods	1	C, D		1
10.	**UNIT II – Magneto statics**	**9**			

11.	Biot- savart law, Ampere's force law	1	C, D		2
12.	Magnetic flux density and Gausses' Law	1	C, D		2
13.	Magnetic vector potential Magnetic torque and moments	1	C		2
14.	Magnetic field intensity and Ampere's circuit law	1	C		2
15.	Magnetic scalar potential	1	C, D		2
16.	Magnetization in material	1	C, D		2
17.	Magnetic boundary condition	1	C		2
18.	Magnetic energy, Force on magnetic material	1	C, I		2
	UNIT-III Time-varying electromagnetic fields	**9**			
19.	Motional electromotive forces	1	C, D		1, 2
20.	Faraday's law of induction	1	C, D		1, 2
21.	Displacement current, Maxwell's equations	1	C		1, 2
22.	Self and mutual inductance, Inductance in coupled coils	1	C		1, 2
23.	Maxwell's equations from Ampere's and Gauss's law, their physical significance	1	C, D		1, 2
24.	Maxwell's equations and boundary conditions	1	C, D		1, 2
25.	Pointing theorem	1	C		1, 2
26.	Time harmonic fields	1	D, I		1, 2
27.	Applications of electromagnetic fields	1	C, I		1, 2
	UNIT IV: Plane wave propagation	**9**			
28.	General wave equations, Power & Pointing vector	1	C, D		1, 3
29.	Plane wave in free space and dielectric medium	1	C, D		1, 3
30.	Plane wave in a conducting medium	1	C		1, 3
31.	Plane wave in a good conductor and dielectric	1	C		1, 3
32.	Polarization of electromagnetic waves	1	C, I		1, 3
33.	Normal incidence of uniform plane waves	1	C, I		1, 3
34.	Oblique incidence of uniform plane waves	1	C, D		1, 3
35.	Transverse magnetic waves (TM)and Transverse electric waves (TE)	1	D, I		1, 3
36.	Losses in waveguide	1	D, I		1, 3
	UNIT-V: Transmission lines	**9**			
37.	Concept of lump and distributed parameters, Transmission line equations	1	C, D		1, 3

38.	Lossless propagation, Examples of transmission lines -, characteristic impedance	1	C, D		1, 3
39.	Lossless propagation of sinusoidal voltages - complex analysis	1	I		1, 3
40.	Transmission line equations and their solutions in phasor form, input impedance	1	C, D		1, 3
41.	Power transmission and the use of decibels in loss characterization	1	C, I		1, 3
42.	Refection of waves at discontinuous points	1	C, D		1, 3
43.	Standing waves in transmission lines - Voltage standing wave ratio	1	C, D		1, 3
44.	Transients in transmission line	1	D, I		1, 3
45.	Skin effect and resistance, skin depth	1	D, I		1, 3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]/OTHER READING MATERIA[c]
1[a]	Principles of Electromagnetics - Mathew N.O. Sadiki and S.V. Kulkarni, 6 Edition (2016), Publisher - Oxford University Press
2[a]	Introduction to Electrodynamics - David J. Griffiths, 4th Edition (2015) Publisher - Pearson Education India Learning Private Limited
3[a]	Electromagnetic Field Theory Fundamentals - B S Guru & H R Hizirogul, II Edition (2017), Publisher – Cambridge university press
4[b]	Engineering Electromagnetic - W.H. Hyat & J.A. Buck, XIII Edition (2010), Publisher - McGraw-Hill
5[b]	Theory and problems of Electromagnetic - Edminister, II Edition(2011), Publisher – Tata McGraw-Hill
6[b]	Electromagnetic Field Theory (Including Antennas and Wave Propagation) -K. A. Gangadhar and P. M. Ramnathan Khanna Publishers (1997)
7[c]	NPTEL Lecture: Introduction to Electromagnetic Theory, by Prof. Pradeep Kumar, IIT Kanpur

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	Computer-aided analysis	Project	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

PHY 221	Electricity and Magnetism	L	T	P	C
		2	0	0	2
Co-requisite:	NIL				
Prerequisite:	Engineering Physics (PHY 101)				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Physics				
Approval					

PURPOSE	The course aims to cover the fundamental formalism and applications of static electricity and magnetism laws. It mainly includes Coulombs and Gausses Law of static charges, properties and application of dielectrics in capacitors, and basic knowledge of Magneto statics.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
The course aims to cover the fundamental formalism and applications of static electricity and magnetism laws. It mainly includes Coulombs and Gausses Law of static charges, properties and application of dielectrics in capacitors, and basic knowledge of Magneto statics.								
1.	Apply the fundamental concepts of electricity and magnetism as needed for further studies in their engineering and technology.							
2.	Students' physical intuition and thinking process through understanding the theory of electricity and magnetism.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I INTRODUCTION TO VECTOR ALGEBRA	**9**		I	
1.	Gradient, Divergence and curl and their physical significances	3	C, D	I	2
2.	Gauss and Stokes theorems, Vector operators in different coordinate (Curvilinear, Cartesian, Cylindrical and spherical) systems	6	C, D	I	1
	UNIT-II ELECTROSTATICS	**9**			
3.	Coulomb's law, Gauss law, Electric field, Electrostatic Potential	3	C, D	I	1
4.	Potential energy of system of charges	3	C, D	I	1
5.	Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system, Method of image charge	3	D	I	2
	UNIT- III DIELECTRICS AND POLARIZATION	**9**			
6.	Electric dipole and dipole moment, Electric potential due dipole	2	C, D	I	1
7.	Electric field intensity due to dipole, Polarization P, Electric displacement D	2	C, D	I	1
8.	Electric susceptibility and dielectric constant, Bound volume and surface charge densities	3	D	I	2

9.	Electric field at an exterior and interior point of dielectric.	2	D	I	2
	UNIT-IV MAGNETOSTATICS	**9**			
10.	Biot-Savart law, Ampere's law for force between two current carrying loops	2	C, D	I	3, 4
11.	Ampere's circuital law, Equation of continuity, Magnetic vector potential A	2	C, D	I	5
12.	Energy density in magnetic field, magnetization of matter (B, H, M) Magnetic susceptibility and permeability	3	D	I	3, 5
13.	Hysteresis loss, B-H curve, Diamagnetic, paramagnetic and ferromagnetic substances	2	D	I	5
	UNIT – V INTRODUCTION TO ELECTRODYNAMICS	**9**			
14.	Time varying fields: Faradays law of induction, generalization of Amperes' law, Maxwell's equation (Differential and Integral form), Wave equation and plane waves in free space	9	C, D	I	1, 3
	Total contact hours	**45**			

REFERENCE	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	MIT-- 8.02X online course material
2.	Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012)
3.	Electricity and Magnetism (Reprints 2007, 1st Edition 2001) A. S. Mahajan, A. A.Rangwala, (Publisher - McGraw-Hill Education)
4.	Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013
5.	Classical Electrodynamics (3rd Edition) - John David Jackson (Publisher – Wiley)

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

PHY 221 L	Electricity and Magnetism Laboratory	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	Engineering Physics (PHY 101L)				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Physics				
Approval					

PURPOSE	The course aims to cover the fundamental formalism and applications of static electricity and magnetism laws. It mainly includes Coulombs and Gausses Law of static charges, properties and application of dielectrics in capacitors, and basic knowledge of Magneto statics.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
1.	Apply the fundamental concepts of electricity and magnetism as needed for further studies in their engineering and technology							
2.	Students' physical intuition and thinking process through understanding the experiments of electricity and magnetism							

LIST OF EXPERIMENTS

S.No	Experiment name	Objectives
1.	Determination of susceptibility of paramagnetic material	To determine susceptibility of paramagnetic sample by using Quinck's tube method
2.	Dielectric Constant	a) To measure the capacitance as a function of area and distance between the plates. b) To determine the dielectric constant of different dielectric materials.
3.	Four-probe Resistivity Measurement	Measurement of resistivity of a semiconductor by Four-probe method and determination of Energy Band Gap.
4.	Biot-Savart's Law	a) To study the magnetic field along the axis of a current carrying circular loop. b) To study the dependency of magnetic field on the diameter of coil.
5.	Faraday's Law & Induced E.M.F	a) Measurement of the induced voltage impulse as a function of the velocity of the magnet. b) Calculation of the magnetic flux induced by the falling magnet as a function of the velocity of the magnet.
6.	Magnetic Field in Helmholtz Coil	a) To investigate the spatial distribution of magnetic field between coils and determine the spacing for uniform magnetic field. b) To demonstrate the superposition of the magnetic fields of the two individual coils.
7.	Determination of magnetic property of a given material	To demonstrate Dia-Para-Ferro magnetism in a given material using an inhomogeneous magnetic field
8.	Study of B-H-Curve	To study permeability curve of a given material
9.	Hall effect Experiment	To determine the type of charge carrier, carrier density and Hall coefficient of a given semiconductor.

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Introduction to Electrodynamics (4rd Edition) - David J. Griffiths (Publisher - PHI Learning, Eastern Economy Editions, 2012)
2.	Electricity and Magnetism (Reprints 2007, 1st Edition 2001) A. S. Mahajan, A. A.Rangwala, (Publisher - McGraw-Hill Education)
3.	Electricity and magnetism Edward M Purcell, David J Morin, 3rd edition, Cambridge University, 2013
4.	Classical Electrodynamics (3rd Edition) - John David Jackson (Publisher – Wiley)

Course nature				**Practical**	
Assessment Method – Practical Component (Weightage 100%)					
In-semester	**Assessment tool**	Lab performance	Practical model exam	Observation note	**Total**
	Weightage	**20%**	**20%**	**10%**	**50%**
End semester examination Weightage : 50%					**50%**

ECO 121	Principles of Economics	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Economics				
Approval					

PURPOSE	This course will provide you with a basic understanding of the principles of economics. At its core, the study of economics deals with the choices and decisions we make to manage the scarce resources available to us. Microeconomics is the branch of economics that pertains to decisions made at the individual level, such as the choices individual consumers and companies make after evaluating resources, costs, and tradeoffs. This course will also provide the brief structure of macroeconomic issues and international trade.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Analyse relevant economic concepts and economic models which inform the study of economics.	D						
b.	Apply economics associated with supply and demand in determining market equilibrium and the effects of price controls and elasticity.	D	I	J	A			
c.	Apply the principles of economics associated with production and consumption in determining the behavior of individuals and producers in successful markets and situations where markets fail or contribute to income inequality.	D	A	I	J			
d.	Analyze market structures and apply theoretical concepts of perfect competition to identify the behavior of monopolies and imperfect competition.	D	I	A	J			
e.	Analyze the concept of macro-economic issues and international trade	D	I	A	J			

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CONSUMER BEHAVIOR	**16**			
1.	Definition; Scope and method of economics; the economic problem.	1	C	2	1,2,3
2.	Science of economics; the basic competitive model; prices.	1	C	2	1,2,3
3.	Opportunity cost; economic systems; reading and working with graphs.	1	C	2	1,2,3
4.	Concept of Demand and supply.	1	C	2	1,2,3
5.	Equilibrium of market.	1	C	2	1,2,3
6.	The concept of elasticity.	2	C	2	1,2,3
7.	Controls on prices; taxes and the costs of	1	C	2	1,2,3

	taxation.				
8.	Consumer Surplus.	2	C	2	1,2,3
9	Application of consumer surplus.	1	C	2	1,2,3
10.	Budget constraints.	1	C	2	1,2,3
11.	Utility Analysis: Ordinal and cardinal utility analysis.	2	C	2	1,2,3
12.	Income and substitution effect.	1	C	2	1,2,3
13.	Applying theory of Labour.	1	C	2	1,2,3
	UNIT II: PRODUCER THEORY AND MARKET	**9**			
14.	Theory of Production.	1	C	2	1,2,3
15.	Short run and long run production.	1	C	2	1,2,3
16.	Theory of Cost: concepts and definition; types.	1	C	2	1,2,3
17.	Short run and long run cost curves.	1	C	2	1,2,3
18.	Structure of Market.	1	C	2	1,2,3
19.	Perfect competition.	1	C	2	1,2,3
20.	Monopoly.	2	C	2	1,2,3
21.	Monopolistic competition.	1	C	2	1,2,3
	UNIT III: MACRO ECONOMIC ISSUES	**11**			
22.	GDP- definition and concepts.	1	C	2	2,3
23.	Measurement of National Income: Different methods	1	C	2	2,3
24.	Consumption function.	1	C	2	2,3
25.	Investment.	1	C	2	2,3
26.	Demand for money.	2	C	2	2,3
27.	Supply of Money.	2	C	2	2,3
28.	Inflation.	2	C	2	2,3
29.	Unemployment.	1	C	2	2,3
	UNIT IV: INTERNATIONAL TRADE	**6**			
30.	Balance of payments.	2	C	2	2,3
31.	International trade.	1	C	2	2,3
32.	Trade balance.	1	C	2	2,3
33.	The foreign exchange markets.	2	C	2	2,3
	Unit V:	**3**			
34.	Feature of the Indian Economy	1	C	2	4
35.	Inclusive Growth; relevance for the Indian Economy.	1	C	2	4
36.	Sustainable Development.	1	C	2	4
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition.
2.	Principles of Economics, Case Karl E, Fair Ray C; Oster Sharon M, Publisher: Pearson tenth

	edition.
	Economics, Samuelson P A and Nordhus W D; Publisher: McGraw-Hill Irwin.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Class Test	Quiz	**Total**
	Weightage	**15%**	**15%**	**10%**	**5%**	**5%**	**50%**
End semester examination Weightage : 50%							**50%**

		3	**0**	**0**	**3**
Co-requisite:					
Prerequisite:	Applied Creative & Critical Thinking				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Mathematics				
Approval					

PURPOSE	In this course, students are introduced to a number of tools from probability and statistics and learn the basics of data science. They will practice extracting useful information from data, represent problems formally, and interpret results. They cover a number of statistical topics including Probability and conditional probability, Populations and samples, Random variables, descriptive statistics, and distributions, Correlates, controls, and confounds, Models of random systems including regression models, Inference, confidence, and significance, Professional standards in data science and related quantitative disciplines.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Define, collect, sample, manipulate, and synthesize data (measurements gathered from events).							
2.	Use equations to build and test probabilistic models that approximate the behavior of real systems.							
3.	Use appropriate quantitative tools and techniques, exhibit professionalism in quantitative fields.							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT-I Course Overview and Tools	**6**			
1.	Course overview and introduction	3			
2.	What is randomness?	3			
	UNIT-II Describing Patterns in Data	**15**			
3.	Variables	2			
4.	Descriptive Statistics	2			
5.	Probability I	2			
6.	Correlation I	1			
7.	Distributions I	1			
8.	Distributions II	1			
9.	Probability II	1			
10.	The Central Limit Theorem	2			

11.	Synthesis: Regression to the Mean	2			
	UNIT- III Making Predictions with Models.	**8**			
12.	Conditional Probability	1			
13.	Correlation II	1			
14.	Simple Regression	1			
15.	Multiple Regression	1			
16.	Bayes' Theorem	2			
17.	Bayesian Inference	1			
18.	Correlation and Regression Synthesis	1			
	UNIT-IV Testing Models with Data	**10**			
19.	Effect Size I	2			
20.	Effect Size II	2			
21.	Confidence Intervals II	2			
22.	Significance I	2			
23.	Significance II	2			
	UNIT – V Course Synthesis	**3**			
24.	Synthesis Part I	3			
	UNIT – VI: Training Resources	**3**			
25.	Descriptive Statistics	3			
	Total contact hours	31			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Diez, D., Barr, C., & Cetinkaya-Rundel, M. (2015). OpenIntro Statistics (3rd ed.). OpenIntro.org
2.	Magnus, P. D. (2005). Chapter 1. In forallx: An introduction to formal logic.

EGL 121	**Critical Thinking**	**L**	**T**	**P**	**C**

		3	**0**	**0**	**3**
Co-requisite:					
Prerequisite:	Communicative English				
Data Book / Codes/Standards					
Course Category	Humanity Sciences				
Course designed by	Department of English				
Approval					

PURPOSE	Logical reasoning, problem solving, and recognizing and mitigating cognitive biases are among the most fundamental skills that facilitate elective work in any area. In this course, learners will gain a foundation in critical and creative thinking upon which they can build expertise in disciplinary knowledge.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, students will be able to								
a.	Identify and Organize problems into tractable components and design solutions	C	D	I	O			
b.	Evaluate and use effective strategies to learn or teach specific types of material	C	D	I	O			
INSTRUCTIONAL OBJECTIVES								
1. To understand the nature of problem and evaluate claims.								
2. To familiarize the learners with methods and techniques of active learning.								
3. To identify fallacies and apply inductive reasoning.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**12**			
1.	Analyzing Problems.	4		1	1
2.	Science of Learning.	4			1
3.	Logical Thinking.	4			1
	UNIT-II	**12**			
4.	Analyzing Decisions.	6		1	2
5.	Applying logic.	6			2
	UNIT - III	**16**			2
6.	Evaluating Claims and Justifications.	4		3,4	3
7.	Fallacy Detection.	4			3
8.	Understanding Bias.	4			3
9.	Mitigating Bias.	4			3
	UNIT- IV	**10**			

10.	Evaluate and Use Strategies.	4		3,4	4
11.	Identifying the Right Problem and Sub problems.	2			4
12.	Gaps and Constraints.	4			4
	UNIT-V	**10**			
13.	Solving Problems.	2		2,3	5
14.	Using Analogies in Problem Solving.	4			5
15.	Innovative Thinking.	4			5
	Total Contact Hours	**60**			

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	CLA – 1	CLA – 2	Quiz	**Total**
	Weightage	**15%**	**15%**	**15%**	**15%**		**60%**
End semester examination Weightage : 40%							**40%**

MAT 121	Multivariable Calculus	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Mathematics				
Approval					

PURPOSE	The course will cover the theory of Calculus in two- and three-dimensional Euclidean space. This includes familiarizing the student with geometry in two and three dimensions, and differentiation and integration of functions of two and three variables.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a	Understand differentiation of functions of two and three variables.							
b.	Understand partial derivatives and have an acquaintance of some partial differential equations.							
c.	Understand integration in both two and three dimensions.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – Vectors and the Geometry of Space	**17**			
1.	Three-dimensional coordinate system, distance, spheres.	3	C		1,2,3
2.	Vectors.	2	C		1,2,3
3.	Dot product, properties, vector projection.	3	C		1,2,3
4.	Cross Product, triple scalar, or box product.	3	C		1,2,3
5.	Lines and Planes.	4	C		1,2,3
6.	Extra examples.	2	C		1,2,3
	UNIT II – Partial Derivatives	**20**			
7.	Functions of several variables.	3	C		1,2,3
8.	Graphical software.	1	C		1,2,3

9.	Limits and continuity in several variables.	4	C		1,2,3
10.	Partial derivatives.	3	C		1,2,3
11.	The Chain Rule.	2	C		1,2,3
12.	Directional derivative.	2	C		1,2,3
13.	Gradient.	2	C		1,2,3
14.	Extra exercises, heat equation, wave equation, Laplace equation in two and three dimensions.	3	C		1,2,3
	UNIT III – Extreme Values	**8**			
15.	First derivative test for local extreme values.	2	C		1,2,3
16.	Second derivative test, saddle points, Hessian.	2	C		1,2,3
17.	Lagrange Multipliers.	2	C		1,2,3
18.	Further examples.	2	C		1,2,3
	UNIT IV – Integration in Two Dimensions	**9**			
19.	Double integrals over rectangles.	2	C		1,2,3
20.	Double integrals over general regions, Fubini's Theorem.	2	C		1,2,3
21.	Further examples of double integrals.	2	C		1,2,3
22.	Area.	1	C		1,2,3
23.	Integration using Polar Coordinates	2	C		1,2,3

	UNIT V – Integration in Three Dimensions	**6**			
24.	Triple Integrals in rectangular coordinates.	3			
25.	Volume, average value.	3			
	Total contact hours	**60**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Thomas' Calculus, 14th Edition, (2018) – J. Hass, C. Heil, M. Weir, Pearson Education.
2.	Introduction to Real Analysis, Fourth Edition (2014) – R. Bartle, D. Sherbert, John Wiley and Sons.
3.	Calculus and Analytic Geometry, Ninth Edition (2017) – G. Thomas, R. Finney, Addison Wesley.
4.	Differential and Integral Calculus, vol. II, (1961) – R. Courant, Blackie & Son Ltd., London and Glasgow.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	MID Term I	MID Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

CDC 102	Soft Skills-II	L	T	P	C
		1	1	0	1
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Skill building				
Course designed by	Department of Career Development Centre				
Approval					

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	An ability to apply knowledge of mathematics, science and engineering							
2.	An ability to function on multidisciplinary teams							
3.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic							
4.	Build vocabulary through methodical approaches and nurture passion for learning new words							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**8**			
1.	Percentages, profit and loss, SI and CI	4	C and I		1
2.	Time and work, Average and progression.	4	C and I		1
	UNIT-II	**6**			
3.	Time – speed and distance	3	C and I		1
4.	Number system and arrangements	3	C and I		1,2
	UNIT- III	**6**			
5.	Ratio and proportions, Mixtures and Alligation, Direction problems	3	C and I		1
6.	Direction problems, coding and decoding, Number series and Alphabet series.	3	C and I		2
	UNIT-IV	6			
7.	Antonyms, synonyms, odd words	3	C and I		3,4
8.	Idioms and phrasal verbs, same word with different part of speech.	3	C and I		3,4
	UNIT-V	6			

9.	Word analogy. Sentence completion	3	C and I		5,6,7
10.	Text completion, Sentence equivalence	3	C and I		5,6,7
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Arun Sharma – *How to prepare for Quantitative Aptitude,* Tata Mcgraw Hill.
2.	RsAgarwal,*A Modern Approach to Verbal and Non Verbal Reasoning,* S.Chand Publications.
3.	Verbal Ability and Reading comprehension-Sharma and Upadhyay.
4.	Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
5.	GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition
7.	The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLAI	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

SEMESTER III

EEE 201	Electrical and Electronics Measurement	L	T	P	C
		3	0	0	3
Co-requisite:					
Prerequisite:	Engineering Physics (PHY 101), Fundamentals of Electrical Engineering (EEE 102), Multivariable Calculus (MAT 121)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	Explain basic concepts and definitions in measurement. Describe the bridge configurations and their applications. Elaborate discussion about the importance of signal generators and analyzers in Measurement.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Recognize the evolution and history of units and standards in Measurements.							
b.	Identify the various parameters that are measurable in electronic instrumentation.							
c.	Employ appropriate instruments to measure given sets of parameters.							
d.	Practice the construction of testing and measuring set up for electronic systems and relate the usage of instrumentation standards.							
e.	To have a deep understanding about instrumentation concepts which can be applied to control systems.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference

		UNIT I: Fundamentals of Measuring Instruments	**9**			
	1.	Instrumentation and Measurements.	1	C, D		1
	2.	Measuring Instruments and classifications.	1	C		1
	3.	Static and Dynamic Characteristics of Measurement System.	1	C		1, 2
	4.	Error in Measurements.	1	C, D		1
	5.	Principle of operation - Permanent Magnet Moving Coil (PMMC) Instrument.	1	C, D		1, 2
	6.	Constructional Details of moving coil instrument.	1	C		1, 2
	7.	Characteristic equations and Operating Torques.	1	D, I		1, 2
	8.	PMMC as voltmeter and Ammeter.	1	D, I		1, 2
	9.	Magnetic Measurements - Ballistic Galvanometer.	1	D, I		1, 2
	10.	**UNIT II: Measurement with Analog Instruments**	**9**			
	11.	Moving-Iron Instruments	1	C, D		1, 2
	12.	Electrodynamometer-Type Instruments	1	C, D		1, 2
	13.	Derivation of Deflecting Torque in Electrodynamic, Electrostatic & Moving Iron Instrument	1	C		1, 2
	14.	Power Measurement in dc and ac Circuits	1	C		1, 2
	15.	Electrodynamometer and Induction-type Wattmeter	1	C, D		1, 2
	16.	Reactive Power Measurements	1	C, D		1
	17.	Single-Phase Induction-type Energy Meter	1	C		1
	18.	Errors in Induction-type Energy Meters and Their Compensation	1	C, I		1, 2
		UNIT-III: Instrument Transformers	**9**			
	19.	Advantages of Instrument Transformers, their variation on applications	1	C, D		2
	20.	Theory of Current Transformers (CT)	1	C, D		2
	21.	Design and Constructional Features of CT	1	C		2
	22.	Operational Characteristics and Errors Introduced by CT	1	C		2
	23.	Theory of Potential Transformers (PT)	1	C, D		2
	24.	Design and Constructional Features of PT	1	C, D		2
	25.	Operational Characteristics and Errors Introduced by PT	1	C		2
	26.	Differences between CT and PT, Industrial applications	1	D, I		2
	27.	Power Measurement with Instrument Transformers	1	C, I		2
		UNIT IV: Potentiometer and Bridges	**9**			
	28.	Crompton's dc Potentiometers and applications	1	C, D		1, 2
	29.	AC Potentiometers – classifications, applications, advantages and disadvantages	1	C, D		1, 2

	30.	General Balance Equation for Four-Arm Bridge	1	C		1, 2
	31.	Measurement of resistance - Wheatstone's bridge	1	C		1, 2
	32.	Measurement of low resistance - Kelvin's double bridge, its applications	1	C, I		1, 2
	33.	General Balance Equation for Four-Arm AC Bridge.	1	C, I		1, 2
	34.	Measurement of inductance-Maxwell's bridge, Hay bridge.	1	D, C		1, 2
	35.	Measurement of capacitance and loss angle - De Sauty's bridge, Schering bridge.	1	D, I		1, 2
	36.	Frequency measurement and Wagner Earthing Device.	1	I		1, 2
		UNIT-V: Measurement with Electronic Instruments	**9**			
	37.	Block diagram of and working principle of Digital Storage Oscilloscope (DSO).	1	C, D		3
	38.	Measurement of Electrical Quantities, Voltage, Current and phase using DSO.	1	C, D		3
	39.	Electronic Voltmeters (DVMs).	1	I		3
	40.	Digital Frequency Meter.	1	C, D		3
	41.	Electrical Transducers.	1	C, I		3
	42.	Linear Variable differential Transformer (LVDT).	1	C, D		3
	43.	Strain Gauges and Electromagnetic Flow Meter.	1	C, I		3
	44.	Temperature Transducers Pressure Measurement.	1	D, I		3
	45.	Virtual Instrumentation using LabView.	1	D, I		3
		Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]/OTHER READING MATERIAL[c]
1[a]	A Course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, 19th Revised Edition, Dhanpat Rai & Co.
2[a]	Electrical Measurements and Measuring Instruments, E.W. Golding and F.C. Wides,3rd Edition, Wheeler Publishing.
3[a]	Modern Electronic Instrumentation and Measurement, Albert D.Helstrick and William D.Cooper, Pearson Education. Selected portion from Ch.1, 5-13.
4[b]	Electrical and Electronic Measurement and Instrumentation, R.K. Rajput,4th Edition, S. Chand.
5[c]	NPTEL lecture series "Electrical Measurement and Electronic Instruments" by Prof. A Chatterjee, IIT Kharagpur.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Computer-aided	Project	**Total**

				analysis		
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

EEE 201 L	Electrical and Electronics Measurement Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Electrical And Electronics Measurement (EEE 201)				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	The course aims to cover the hand-on and practical applications related to fundamental formalism of Electrical Engineering. It mainly includes measurement with analog instruments, industrial transformers, high/low resistance, inductance and capacitance measurements with potentiometer and a.c. bridges, measurement method with electronic instruments.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a	Understand basic equipment operation and analysis							
b.	Correlate fundamental concept of electrical measurements through laboratory experiments							
c.	Origin and analysis of error							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Introduction to different types of Instruments-Moving coil, moving iron, energy meters, oscilloscope, and digital voltmeters. * * This exercise can be carried out once a topic is introduced in the class.	1	D, I, O		1, 2
2.	Calibrate moving iron type ammeter/voltmeter by potentiometer.	1	I, O		1, 2
3.	Calibrate wattmeter by d.c. potentiometer.	1	I, O		1, 2
4.	Calibration of Energy Meter.	1	I, O		1, 2
5.	Measurement of power using Instrument transformer.	1	I, O		1, 2
6.	Measurement of low Resistance using Kelvin double bridge.	1	I, O		1, 2
7.	Measurement of Inductance by Maxwell bridge.	1	I, O		1, 2
8.	Measurement of Capacitance by De Sauty Bridge.	1	I, O		1, 2
9.	Measurement of Capacitance by Schering Bridge.	2	I, O		1, 2
10.	Measurement of frequency by Wien's bridge.	1	I, O		1, 2
11.	Measurement of amplitude and frequency of an ac signal using DSO.	1	I, O		1, 2
12.	Amplitude, phase and frequency measurement of combined ac signals using Lissajous patterns.	2	I, O		1, 2
13.	Electronic Voltmeter circuits.	1	I, O		1, 2
14.	Linear Capacitance meter with IC 555 timer.	1	I, O		1, 2
15.	Instrumentation Amplifier.	1	I, O		1, 2

16.	Virtual Instrumentation using LabView.				
	Total contact hours (Including demo and repeat labs)	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A Course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney,19th Revised Edition, Dhanpat Rai & Co.
2.	NPTEL lecture series "Electrical Measurement and Electronic Instruments" by Prof. Pranab K. Dutta and Prof. A Chatterjee, IIT Kharagpur.

Course nature				**Practical**	
Assessment Method – Practical Component (Weightage 100%)					
In-semester	**Assessment Tool**	Lab performance	Practical model exam	Observation note	**Total**
	Weightage	**20%**	**20%**	**10%**	**50%**
End semester examination Weightage : 50%					**50%**

EEE 202	Electrical Circuit Theory	L	T	P	C
		2	1	0	3
Co-requisite:	Differential Equations (MAT 131)				
Prerequisite:	Fundamentals of Electrical Engineering (EEE 101)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide the comprehensive idea of electrical circuits, network theorems, two-port networks, concept and application of graph theory and filters to circuits

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the basic concepts and behavior of different electrical circuits.							
2.	Apply the techniques of circuit analysis to solution of two -port electrical network problems.							
3.	Get an insight into the solution of complex DC and AC circuits using network theorems.							
4.	Understand the transient behavior of RL, RC, and RLC circuits under dc and ac excitation.							
5.	To learn and apply mathematical techniques to electrical circuits and understand concept of filters.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Basic Circuit Analysis	**9**			
1.	Network Reduction Technique using Star–Delta Transformation.	2	C		1,2
2.	Analysis of electric circuits with voltage dependent voltage source.	2	C		1,2
3.	Analysis of electric circuits with voltage dependent current source.	1	C		1,2
4.	Analysis of electric circuits with current dependent current source.	1	C		1,2
5.	Analysis of electric circuits with current dependent and voltage source.	1	C		1,2
6.	Illustrative examples.	2	C		1,2
	UNIT II: Theorems with both DC and AC Source	**9**			
7.	Introduction to Network Theorems and Techniques, Superposition Theorem.	2	C		1-3
8.	The venin's Theorem.	1	C		1-3
9.	Norton's Theorem.	1	C		1-3
10.	Maximum Power Transfer Theorem.	1	C		1-3
11.	Reciprocity Theorem.	1	C		1-3
12.	Milliman's Theorems, Illustrative examples.	3	C		1-3
	UNIT-III: Two Port Networks Network	**9**			

13.	Introduction to Two Port Networks.	1	C		1-3
14.	Impedance Parameters.	2	C		1-3
15.	Admittance Parameters.	1	C		1-3
16.	Hybrid Parameters.	1	C		1-3
17.	Transmission Parameters.	1	C		1-3
18.	Illustrative examples.	3	C		1-3
	UNIT IV: Transient Analysis of Circuits	**9**			
19.	Introduction to Transient analysis, Step Response of a Series RL circuit under DC Source Excitation.	2	C		1-3
20.	Step Response of a Series RC circuit under DC Source Excitation.	1	C		1-3
21.	Step Response of a Series RLC circuit under DC Source Excitation- Time Constant, Rise Time, Peak Time, Peak Overshoot/Undershoot and Settling Time.	2	C		1-3
22.	Principle of Duality. Transient Response Analysis of Series RL, RC and RLC Circuits with AC Source Excitation.	2	C		1-3
23.	Illustrative examples.	2	C		1-3
	UNIT-V: Graph Theory and Filter Circuits	**9**			
24.	Graph theory**-** Concept of Tree, Branch, Tree link, Incidence matrix.	2	C		1-3
25.	Tie-set matrix and loop currents, Cut set matrix and node pair potentials.	1	C		1-3
26.	Principle of Duality, Illustrative Examples.	1	C		1-3
27.	Passive filters-Concept-Ideal and practical, properties and uses and classification of filter.	2	C		1-3
28.	Concept of low pass and high pass filter using reactive elements.	2	C		1-3
29.	Illustrative examples.	1	C		1-3
	Total contact hours	**45**			

	LEARNING RESOURCES	
		TEXTBOOKS[a]/REFERENCE BOOKS[b]
	1[a]	William H Hayt, J E Kemmerly and Steven M Durbin, "*Engineering Circuit Analysis*", McGraw Hill, 8th Edition, 2011.
	2[a]	Sudhakar. A and Shyam Mohan.S. P, "*Circuits and Networks Analysis and Synthesis*", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
	3[a]	Richard C.Dorf and James A.Svobada "*Introduction to Electric Circuits*", Wiley India Private Limited ,Sixth Edition ,2007
	4[b]	Charles K. Alexander and Matthew N.O. Sadiku, "*Fundamentals of Electric Circuits*" McGraw Hill Higher Education, Third Edition, 2005.
	5[b]	Abhijit Chakrabarti, "*Circuit Theory Analysis and Synthesis*" Dhanpat Rai & Co. 7th Edition, 2017.

Course nature	**Theory**
Assessment Method – Theory Component (Weightage 100%)	

In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE 202 L	Electrical Circuit Theory: Laboratory	L	T	P	C
		0	0	2	1
Co-requisite:	Electrical Circuit Theory (EEE 202)				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	The course aims to give the experimental skills related to fundamental laws and theorems of electrical circuits. The purpose of lab experiments is also to introduce MATLAB a circuit simulation software tool. This course mainly enables the students to gain enough knowledge on circuit construction skills with different circuit elements.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand basic equipment operation and build the electrical circuit connections with safety to the personal.							
b.	Correlate fundamental concept of electrical circuits through laboratory experiments							
c.	Gain acquaintance with simulation platform for solution of circuits.							
d.	Design different types of filters and differences between theory and practice.							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Verification of Ohm's Law.	2	I, O		1-3
2.	Verification of Kirchoff's Current Law.	2	I, O		1-3
3.	Verification of Kirchoff's Voltage Law.	2	I, O		1-3
4.	Verification of Superposition theorem.	2	I, O		1-3
5.	Verification of Thevenin's theorem.	2	I, O		1-3
6.	Verification of Norton's theorem.	2	I, O		1-3
7.	Verification of Maximum Power transfer theorem.	2	I, O		1-3
8.	Verification of Reciprocity theorem.	2	I, O		1-3
9.	Calculation of Z parameters using MATLAB simulation.	2	I, O		1-3
10.	Calculation of Y parameters using MATLAB simulation.	2	I, O		1-3
11.	Design of low pass filter using MATLAB simulation.	2	I, O		1-3
12.	Design of high pass filter using MATLAB simulation.	2	I, O		1-3
	Total contact hours (Including demo and repeat labs)	**24**			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	William H Hayt, J E Kemmerly and Steven M Durbin, "*Engineering Circuit Analysis*", McGraw Hill, 8th Edition, 2011.
2.	Circuit Theory Analysis and Synthesis, Abhijit Chakrabarti, Dhanpat Rai & Co. 7th Edition, 2017.
3.	Fundamentals of Electric Circuits, Charles K. Alexander, and Matthew N.O. Sadiku, McGraw Hill Higher Education, Third Edition, 2005.

Course nature				**Practical**	
Assessment Method – Practical Component (Weightage 100%)					
In-semester	**Assessment Tool**	Lab performance	Practical model exam and Viva	Observation note	**Total**
	Weightage	**20%**	**20%**	**10%**	**50%**
End semester examination Weightage: 50%					**50%**

ECE 211	Digital Electronics	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Open Electives				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	To acquire the basic knowledge of digital logic levels and application of the fundamentals to understand digital electronic circuits. To impart how to design Digital Circuits both theoretically and practically.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Convert the different type of codes and number systems which are used in digital communication and computer systems.							
2.	Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance, and efficiency.							
3.	Analyze different types of the digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.							
4.	Design different types of with and without memory element digital electronic circuits for a particular operation, within the realm of economic, performance, efficiency, user-friendly and environmental constraints.							
5.	Understand further about combinational, asynchronous sequential, and synchronous sequential digital logic circuits							
6.	Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real-world application.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I :DIGITAL FUNDAMENTALS	**9**			
1.	Number System, Basic logic gates. Boolean algebra.	1	C		1,2,3
2.	De Morgan's laws, 1's and 2's complements.	1	C-D		1,2,4
3.	Minterms and Maxterms.	1	C-D		1,2,4
4.	Sum of products and product of sums.	1	C-D-I		1,2,8
5.	Introduction to Karnaugh maps (up to 4 variable)	1	C-D-I-O		1,3,4

6.	Codes – Binary. BCD, Excess 3.	1	C		1,2
7.	Gray, Alphanumeric codes.	1	C-D		1,2
8.	Prime Implicants.	1	C-D-I		1,2
9.	Essential Prime Implicants.	1	C-D-I		1,2
	UNIT II :COMBINATIONAL CIRCUIT DESIGN	**9**			
10.	Half Adder & Full Adder.	1	C-D-I-O		1
11.	Half Subtractor & Full Subtractor.	1	C-D-I-O		1,2
12.	Binary Parallel Adder.	1	C-D-I-O		1,2
13.	Carry look ahead adder.	1	C-D-I-O		1,2
14.	BCD Adder.	1	C-D-I-O		1
15.	Encoder, Priority Encoder.	1	C-D-I-O		1,2
16.	Decoder, Multiplexer	1	C-D-I-O		1,2,3
17.	Demultiplexer.	1	C-D-I-O		1,2,8
18.	Magnitude Comparator.	1	C-D-I-O		1,3
	UNIT III :SYNCHRONOUS SEQUENTIAL CIRCUITS	**9**			
19.	Latches, Flip flops – SR, JK, T, D. Master/Slave FF.	1	C-D-I-O		1
20.	operation and excitation tables. Triggering of FF.	1	C-D-I-O		1
21.	Analysis and design of clocked synchronous sequential circuits.	1	C-D-I-O		1
22.	Design – Moore/Mealy models. State minimization, State assignment.	1	C-D-I		2
23.	Circuit implementation – Design of Counters.	1	C-D-I-O		1,2
24.	Ripple Counters, Ring Counters.	1	C-D-I-O		1,2,3
25.	Johnson Counters, Shift Registers.	1	C-D-I-O		1,2
26.	Universal Shift Register. Asynchronous sequential circuits.	1	C-D-I-O		1,3,4
27.	brief introduction, operation of asynchronous up/down counter.	1	C-D-I-O		1,3,4
	UNIT IV: MEMORY DEVICES	**9**			
28.	Classification of memories – ROM.	1	C		4
29.	ROM organization – PROM.	1	C-D		4

30.	EPROM – EEPROM –EAPROM. RAM	1	C-D		4
31.	RAM organization. Write operation – Read operation.	1	C-D-I		4
32.	Programmable Logic Devices.	1	C		4
33.	Programmable Logic Array (PLA).	1	C-D-I-O		4
34.	Programmable Array Logic (PAL).	1	C-D-I-O		1,2,4
35.	Field Programmable Gate Arrays (FPGA).	1	C-D-I-O		1,2,4
36.	Implementation of combinational logic circuits using ROM, PLA, PAL.	1	C-D-I-O		1,2,4
	UNIT V: DIGITAL IC FAMILIES	**9**			
37.	Introduction to Digital Integrated Circuits, Diode-logic (DL).	2	C-D		2
38.	Diode-transistor logic (DTL), Resistor.	1	C-D-I		2
39.	transistor logic (RTL), Transistor-transistor logic (TTL).	2	C-D-I		1,2
40.	Emitter-coupled logic (ECL)	1	C-D-I		1,4
41.	Metal-oxide semiconductor (MOS)	1	C-D-I		1,2
42.	Complementary Metal-oxide semiconductor (CMOS) their operation and comparison.	2	C-D-I-O		1,3,5
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	M. Morris Mano, "Digital Design", 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014.
2.	John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
3.	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
4.	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
5.	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
6.	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
7.	Donald D.Givone, "Digital Principles and Design", TMH, 2003.
8.	Anil K. Maini, "Digital Electronics", Wiley, 2014.

Course nature	**Theory**

Assessment Method (Weightage							
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA 1	CLA 2	**Total**	**Final**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**	**50%**
End semester examination Weightage: 50%							**50%**

ECE 211 L	Digital Electronics Lab	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Open Electives				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	To acquire the basic knowledge of digital logic levels and application of the fundamentals to understand digital electronic circuits. To impart how to design Digital Circuits both theoretically and practically.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Convert the different type of codes and number systems which are used in digital communication and computer systems.							
2.	Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance, and efficiency.							
3.	Analyze different types of the digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.							
4.	Design different types of with and without memory element digital electronic circuits for a particular operation, within the realm of economic, performance, efficiency, user-friendly and environmental constraints.							
5.	Understand further about combinational, asynchronous sequential, and synchronous sequential digital logic circuits							
6.	Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real-world application.							

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Realization of Basic Logic Gates.	1	D-I-O		1
2.	Design of Code Converters (Binary to Gray) & (Gray to Binary).	1	D-I-O		1,2
3.	Design of Half-Adder/Subtractor, Full-Adder/Subtractor, Multiplexers/De Multiplexers ALU Design.	2	D-I-O		1,2
4.	Design of Decoder and Encoder/ BCD 7SSD.	2	D-I-O		1,2
5.	Design of Magnitude Comparator (2-bit).	2	D-I-O		1,2
6.	Design and Verification of Flip-Flops using IC.	1	D-I-O		1,2

7.	Design of Asynchronous Counter (Any Mod, Up and Down, Johnson and Ring).	2	D-I-O		1,2
8.	Design of Synchronous Counter (Any Mod, Decade counter 74ls90).	1	D-I-O		1,2
9.	Design of Universal Shift Register (Serial to Parallel, Parallel to Serial, Serial to Serial and Parallel to Parallel Converters).	2	D-I-O		1,2
10.	Design & Verification of Memory (SRAM).	1	D-I-O		1,2
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	M. Morris Mano, "Digital Design", 5th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2014.
2.	John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
3.	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
4.	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
5.	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
6.	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
7.	Donald D.Givone, "Digital Principles and Design", TMH, 2003.
8.	Anil K. Maini, "Digital Electronics", Wiley, 2014.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

ECE 212	Signals and Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Open Electives				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	This course aims to help the students to understand the basics of signals and systems both in time and transform domains. Upon successful completion of the course, the students will use the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand the mathematical representation of continuous and discrete time signals and systems.							
2.	Develop input/output relationship for linear shift invariant system; understand the convolution operator for continuous and discrete time system.							
3.	Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.							
4.	Understand the limitations of Fourier transform; Understands the necessity of Laplace and Z transform.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I : SIGNALS CLASSIFICATION, TRANSFORMATIONS, REPRESENTATION	**9**	I,O		
1.	Classification of signals: continuous-time/discrete-time. Even odd.	2	I,O		1,2
2.	Periodic-aperiodic, energy-power, random-deterministic.	2	I,O		1,2
3.	Standard signals: impulse, step.	1	I,O		1,2
4.	Ramp, exponential and sinusoids.	1	I,O		1,2
5.	Transformations of the independent variable: shifting.	1	I,O		1,2
6.	Scaling and reversal. Representation of periodic signals using Fourier series.	2	I,O		1,2
	UNIT II : SYSTEMS: CLASSIFICATION AND TIME DOMAIN ANALYSIS	**9**			
7.	Classification of systems: linear-nonlinear.	1	I,O		1,2
8.	Time-invariant/time-variant.	1	I,O		1,2
9.	Memory, causal.	1	I,O		1,2

10.	Continuous-time/discrete-time.	1	I,O		1,2
11.	LTI System properties: causality, memory.	1	I,O		1,2
12.	Stability, and invertibility.	1	I,O		1,2
13.	Impulse response.	1	I,O		1,2
14.	Linear convolution and discrete-time convolution.	1	I,O		1,2
15.	Graphical method to solve convolution.	1	I,O		1,2
	UNIT III: FOURIER SERIES AND FOURIER TRANSFORM	**13**			
16.	Introduction to Fourier series in continuous time domain	2	I,O		1,2
17.	properties of Fourier series	2	I,O		1,2
18.	Exponential Fourier series	1	I,O		1,2
19.	Discrete Fourier series	1	I,O		1,2
20.	Introduction to continuous time Fourier Transform	2	I,O		1,2
21.	Properties of Fourier transform	2	I,O		1,2
22.	CTFT of periodic signals.	1	I,O		1,2
23.	Discrete time Fourier transform (DTFT) and its properties.	1	I,O		1,2
24.	DTFT of periodic signals	1	I,O		1,2
	UNIT IV: LAPLACE TRANFORM	**7**			
25.	Introduction to Laplace transform and region of convergence.	2	I,O		1,2
26.	Properties of Laplace transform.	2	I,O		1,2
27.	Inverse Laplace transform.	1	I,O		1,2
28.	Initial and final value theorems.	2	I,O		1,2
	UNIT IV: Z TRANFORM	**7**			
29.	Introduction to Z-transform and its region of convergence.	2	I,O		1,2
30.	Properties of Z-transform.	2	I,O		1,2
31.	Inverse Z-transform.	1	I,O		1,2
32.	The unilateral Z-transform.	7	I,O		1,2
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	"Signals and Systems" by Oppenheim, Wilsky and Nawab, Prentice Hall, 2nd edition. ISBN: 9780138147570.
2.	"Signals and Systems" by Simon Haykin and Berry van Veen, 2nd edition, ISBN: 9780471164746.
3.	"Principles of Signal Processing and Linear Systems" by B P Lathi, 2nd edition, ISBN: 9780198062271
4.	"Signals and Systems using MATLAB" by Louis F Chaparro, 2014 edition, Academic Press, ISBN: 9780123948434

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

ECE 212 L	Signals and Systems Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Signals and Systems				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Open Electives				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The course aims to give the experimental skills related to fundamentals of signals and systems. The purpose of lab experiments is also to introduce MATLAB/PYTHON simulation software tool related to signals and systems operations. This course mainly enables the students to gain sufficient knowledge on signals and systems for future simulations related to baseband signal processing for wireless communications.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand basic signal design and operations on signals practically.							
b.	Understand the system operations.							
c.	Gain practical experience related to frequency components in the signal.							
d.	Understand concept related to Laplace and z transforms that is useful in system design.							

Sl. No	**Description of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Plotting even and odd components of continuous-time signals.	2	I, O		1-2
2.	Time period calculation of continuous time signals.	2	I, O		1-2
3.	Shifting, scaling and reflection of discrete time signals.	2	I, O		1-2
4.	Energy and power of signals.	2	I, O		1-2
5.	Fourier series representation of periodic signals.	2	I, O		1-2
6.	Convolution between two discrete time signals.	2	I, O		1-2
7.	Finding of Laplace transform.	2	I, O		1-2
8.	Finding of Z-transforms.	2	I, O		1-2
	Total contact hours (Including demo and repeat labs)	**16**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	"Signals and Systems" by Simon Haykin and Berry Van Veen, 2nd edition, ISBN: 9780471164746
2.	"Signals and Systems using MATLAB" by Louis F Chaparro, 2014 edition, Academic Press, ISBN: 9780123948434

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment**	Lab	Model Exam	Lab Report	Mid 1 Lab Viva	**Total**

	tool	Performance				
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

MAT 131	Differential Equations	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Calculus of single variable and Linear Algebra				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Mathematics				
Approval					

PURPOSE	This introductory course on ordinary differential equations (**ODEs**) covers the theory, solution techniques, and applications surrounding linear and non-linear first and second-order differential equations, including systems of equations.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Model some elementary physical situations by writing an appropriate differential equation.							
b.	Be able to solve first order simple, linear, and separable equations							
c.	Solve higher order differential equations using characteristic roots, undetermined coefficients, and the Laplace transform.							
d.	Understand the qualitative nature of the solution to the linear and non-linear systems of equations.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I First Order Differential Equations	**7**			
1.	Classification of ODEs (Linear, Non-linear, Exact, Separable, Geometric meaning of $y' = f(x, y)$, Direction Fields.	1	C		1
2.	Numerical methods for solving ODEs, Euler's Method.	1	C		1
3.	Integrating Factor, Bernoulli Equations.	2	C		1
4.	Initial Value Problem, Existence and Uniqueness, Picard's method.	1	C		1
5.	Modelling (Free falling object, Radioactivity, RL-circuit).	2	C		1
	UNIT-II Second and Higher Order Linear ODEs	**8**			
6.	Homogeneous Linear ODEs.	1	C		1
7.	Modelling of Free Oscillations of a Mass-Spring System.	2	C		1
8.	Euler-Cauchy Equations.	1	C		1
9.	Non-homogeneous ODEs.	2	C		1
10.	Variation of Parameters, Modelling (Forced Oscillations, Electric Circuits).	2	C		1

	UNIT-III System of ODEs	**10**			
11.	Modelling Engineering problems (Electric Network, Mixing problem in two tanks etc.) as systems of ODEs	3	C		1
12.	Wronskian, Phase-Plane Method.	2	C		1
13.	Critical Points & Stability, Qualitative Methods for Nonlinear Systems.	3	C		1
14.	Nonhomogeneous Linear Systems of ODEs.	2	C		1
	UNIT -IV Series Solutions of ODEs	**7**			
15.	Introduction to power series method.	1	C		1,2
16.	Legendre's equation & polynomials.	2	C		1,2
17.	Frobenius Method.	2	C		1,2
18.	Bessel's Equations & Functions.	2	C		1,2
	UNIT-V Laplace Transforms	**12**			
19.	Laplace transforms of standard functions.	1	C		1,3
20.	Shifting Theorems, Transforms of derivatives and integrals.	2	C		1,2
21.	Unit step function, Dirac's delta function.	3	C		1,2
22.	Inverse Laplace transforms, Convolution theorem (without proof).	3	C		1,2
23.	Application: Solutions of ordinary differential equations using Laplace transforms.	3	C		1,2,3

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Willaim Boyce and Richard DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 11th Edition, Wiley-India.
2.	Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, Wiley-India.
3.	Mary L. Boas, *Mathematical Methods in Physical Sciences*, 3rd Edition, Wiley-India.
4.	G. F. Simmons, *Differential Equation with Applications and Historical Notes*, TATA McGraw Hill.
5.	S. Vaidyanathan, *Advanced Applicable Engineering Mathematics*, CBS Publishers.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	Project	**Total**
	Weightage	**15%**	**15%**	**5%**	**10%**	**5%**	**50%**
End semester examination Weightage: 50%							**50%**

ENG 101	Fundamentals of Mechanical Engineering	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Mechanical Engineering				
Approval					

PURPOSE	This course provides students with basic mechanical engineering concepts and workings of mechanical equipment used in everyday life, generic engineering skills and professional responsibility to others that should be integral to their University studies and later professional practice. The course is taught through using several modes including: Problem-, Project- and Experiential-Based Learning. Students learn by undertaking a design project. Oral communication also forms major component of the course. The course includes guest speakers and class demonstrations too.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Gain a general understanding of major fields of mechanical engineering that the students can apply in interdisciplinary projects	a	b	e				
b.	Demonstrate teamwork skills and engineering design process	d	g					
c.	Appreciate engineering ethics and become aware of social concerns in engineering practices.	f	h					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – THERMODYNAMICS	**10**			1,2
1.	Sources of Energy, Types of Prime Movers. Basic concepts, Microscopic and macroscopic approach. Thermodynamic system and surrounding.	1			1,2
2.	Properties of a system, Intensive and extensive, Specific and total quantities, Path and point functions.	1			1,2
3.	Thermodynamic process, cycle and equilibrium, Quasi-static, Reversible and Irreversible processes.	1			1,2
4.	Heat and work transfer, displacement work, flow work and other modes of work, p-V diagram.	2			1,2
5.	Zeroth law of thermodynamics, concept of temperature.	2			1,2
6.	First law of thermodynamics, energy, enthalpy, specific heats, limitations of first law, cyclic heat engine, energy reservoirs. Applications of first law.	2			1,2
7.	Statements of second law and their equivalence. Reversibility, Irreversibility and Causes of irreversibility. Carnot cycle, Carnot theorem, Clausius theorem, Concept of entropy.	1			1,2
	UNIT II – HEAT ENGINES	**10**			1,2
8.	Classification of energy sources, Introduction to fuels and combustion, Classification of fuels, calorific value, Global warming	2			1,2

9.	Thermal prime movers, elementary heat engines, working substances, classification of heat engines.	2			1,2
10.	Heat engine cycles – Carnot cycle and its efficiency.	1			1,2
11.	Properties of water, ideal Rankine cycle (vapor power cycle), methods to improve Rankine cycle efficiency.	1			1,2
12.	Air standard cycles, Piston cylinder geometry and arrangement, Ideal Otto cycle.	2			1,2
13.	Ideal Diesel cycle, differences between petrol and diesel engines.	1			1,2
14.	2 stroke engines, differences between 2 stroke and 4 stroke engines, IC Engine components.	1			1,2
	UNIT III – FLUID MECHANICS	**3**			3
15.	Introduction, Physical Properties of Fluids, Relationship Between Stress and Strain-Rate for Newtonian and Non-Newtonian Fluids.	1			3
16.	Description of Fluid Flow, Classification of Flows-Laminar and Turbulent Flows, Measurement of viscosity.	2			3
	UNIT IV: MECHANICAL ENGINEERING EQUIPMENT	**4**			1,2
17.	Pump basics – Classification, Centrifugal, Positive displacement, Reciprocating; Compressor basics - Air compressors, compressor cycle, centrifugal, axial compressor.	1			1,2
18.	Refrigeration basics – vapor compression refrigeration cycle, refrigerant properties, COP; Air conditioning (AC) principle and AC ratings.	1			1,2
19.	Basics of brakes, couplings, and clutches.	1			1,2
20.	Basics of power transmission elements –belt, chain, rope and gear drive systems.	1			1,2
	UNIT V – MATERIALS AND PROPERTIES	**3**			1,2
21.	Engineering materials and their classification.	1			1,2
22.	Stress-strain relationship, tensile and compression test.	1			1,2
23.	Mechanical properties of materials, material failure.	1			1,2
	ENGINEERING ESSENTIALS	**3**			4,5
24.	Business ethics and values (Guest lecture).	1			4
25.	Basics of Engineering graphics - Projections of points, lines and planes, Orthographic Projections: front, top, side; sectional views (Guest lecture).	2			5
	DESIGN PROJECT	**12**			
26.	Selection of team project; guidance in project execution.	12			

	Total contact hours	**45**

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Elements of Mechanical Engineering, Sadhu Singh, S. Chand and Company Ltd. 2013.
2.	Elements of Mechanical Engineering, V. K. Manglik, PHI Publications, 2013.
3.	An Introduction to Mechanical Engineering, Jonathan Wickert, Cengage Learning India Private Limited, 3rd edition, 2015.
4.	A Foundation Course in Human Values and Professional Ethics, R.R. Gaur, R. Sangal and G.P. Bagaria, Excel Books, 2010.
5.	Elementary Engineering Drawing (First Angle Projection), Bhatt, N.D., Charotar Publishing Co., Anand, 1999.
	REFERENCE BOOKS/OTHER READING MATERIAL
1.	Basic Mechanical Engineering, C.M. Agrawal, Basant Agrawal, Wiley, 2008
2.	Studying Engineering: A Road Map to a Rewarding Career, Landis, R.B., Discovery Press, (1995)

Course nature				**Theory & Project**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Assignment	Project	Project Presentation	**Total**
	Weightage	**10%**	**15%**	**10%**	**15%**	**10%**	**60%**
End semester examination Weightage: 40 %							**40%**

CDC 221	Aptitude	L	T	P	C
		1	1	0	1
Co-requisite:	Nil				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Skill Building				
Course designed by	Department of Career Development Centre				
Approval					

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	An ability to apply knowledge of mathematics, science and engineering							
b.	An ability to function on multidisciplinary teams							
c.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic							
d.	Build vocabulary through methodical approaches and nurture passion for learning new words							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	8			
1.	Percentages, profit and loss, SI and CI.	4	C and I		1
2.	Time and work, Average and progression.	4	C and I		1
	UNIT-II	6			
3.	Time – speed and distance.	3	C and I		1
4.	Number system and arrangements.	3	C and I		1,2
	UNIT- III	6			
5.	Ratio and proportions, Mixtures and Alligation, Direction problems.	3	C and I		1
6.	Direction problems, coding and decoding, Number series and Alphabet series.	3	C and I		2
	UNIT-IV	6			
7.	Antonyms, synonyms, odd words.	3	C and I		3,4
8.	Idioms and phrasal verbs, same word with different part of speech.	3	C and I		3,4
	UNIT-V	6			

9.	Word analogy. Sentence completion.	3	C and I		5,6,7
10.	Text completion, Sentence equivalence.	3	C and I		5,6,7
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2.	RsAgarwal,A Modern Approach to Verbal and Non Verbal Reasoning,S.Chand Publications.
3.	Verbal Ability and Reading comprehension-Sharma and Upadhyay.
4.	Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
5.	GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition
7.	The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

CSE 230	Industry Standard Coding Practice 1	L	T	P	C
		0	0	4	1
Co-requisite:	Computer Lab/ Laptop				
Prerequisite:	NIL				
Data Book / Codes/Standards	Listed in Reference				
Course Category	Engineering Sciences				
Course designed by	As per the industry Norms by CCC				
Approval					

PURPOSE	The purpose of this course is bridging the gap between industry and academia, through enabling students on application of problem solving and competitive coding skills irrespective of languages of their choice.

LEARNING OBJECTIVES	
At the end of the course, student will be able to	
a.	Understand importance of mathematics and problem solving approaches for programming.
b.	Understand importance of optimized solutions for problems solving and its relevance to industry.
c.	Implement mathematical and logical understanding approaches to implement test driven development practices.
d.	Start participating in global coding competitions relevant to the syllabus.
STUDENT OUTCOMES	
1.	Able to understand test and development aspects of programming by solving problems at Industry standards.
2.	Able to interpret any given problem using required domain skills, mathematics.
3.	Able to learn applicable methods to optimize solutions for any given problem.
4.	Able to develop programs using C language until elementary data structures with test driven development.

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT - I	**8**			
1.	Problem Solving with - Basic coding practices, Expression Evaluation, Operators Usage, Expressions, Control Structures, Loop & Iterations for all test case scenarios.				1,2
	UNIT - II	**12**			
2.	Problem Solving using time efficient logics, linear list data, Array problems, 2D Arrays and Matrix Data for all test case scenarios.				1,2
	UNIT- III	**8**			
3.	Problem Solving with - Pointers & Memory referencing, String Handling, functions for all te scenarios.				1,2
	UNIT-IV	**8**			

4.	Problem Solving with - parameter passing, Recursions, Recursion Analysis, Structures and unions, Enumerations & Memory allocation for all test case scenarios.				1,2
	UNIT-V	**12**			
5.	Problem solving with - String manipulations. Lists, display patterns, strings, matrix, tuples, dictionaries, modules, packages, exception handling using Python.				2
	Total contact hours	**48**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Problem solving with C++ -9e- Walter Savitch – Pearson.
2.	The complete Reference C, Fourth Edition – Herbert Schildt – MC Graw Hill.
3.	Programming in Python 3, A complete introduction to Python language - 2e - Mark Summerfield – Addison-Wiley.

Course nature				**Theory & Practical's**
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Mid Term Test I	Mid Term Test II	**Total**
	Weightage	**25%**	**25%**	**50 %**
End semester examination Weightage : **50 %**				**50%**

SEMESTER IV

EEE 203	CONTROL SYSTEMS	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	Differential Equations				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers based on stability and performance requirements.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To model, analysis and design of linear feedback control systems.							
2.	To analyze the time response of first and second order systems							
3.	To investigate the stability of closed loop systems							
4.	To understand the frequency response approaches for the analysis of linear time invariant (LTI) systems							

5.	To discuss basic aspects of PID controller design							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction to Control Systems	**9**			1,2,& 3
1.	Concept of feedback and Automatic control, Effects of feedback.	1	C		1,2,& 3
2.	Objectives of control system, Types of Control Systems, Definition of linear and nonlinear systems.	1	C		1,2,& 3
3.	Mathematical modelling of Physical Systems – Mechanical Systems.	1	C		1,2,& 3
4.	Electrical Systems, Electromechanical systems.	1	C		1,2,& 3
5.	Analogous Systems, Transfer function concept. Properties of Transfer function.	1	C		1,2,& 3
6.	Block diagram representation of closed loop systems.	1	C		1,2,& 3
7.	Block diagram algebra.	1	C		1,2,& 3
8.	Signal Flow graphs, Mason’s gain formula.	1	C		1,2,& 3
9.	Illustrative examples.	1	C		1,2,& 3
	UNIT-II Time Response of feedback control systems	**9**			1,2,& 3

10.	Need of test signals, Standard test signals, Step response of First Order Systems and its time domain specifications.	1	C,D		1,2,& 3
11.	Step response of Second Order Systems and its time domain analysis.	1	C,D		1,2,& 3
12.	Concept of undamped natural frequency, damping, overshoot, rise time and settling time.	2	C,D		1,2,& 3
13.	Dependence of time domain performance parameters on natural frequency and damping ratio, Effects of Pole and Zeros on transient response.	1	C,D		1,2,& 3
14.	pole dominance, approximation of higher order systems.	1	C,D		1,2,& 3
15.	Error Analysis-Steady state errors in control systems due to step, ramp and parabolic inputs.	1	C,D		1,2,& 3
16.	Concepts of system types and error constants.	1	C,D		1,2,& 3
17.	Illustrative examples.	1	C		1,2,& 3
	UNIT- III Stability analysis	**10**			
18.	Concepts of stability, Necessary conditions for Stability,	1	C		1,2,& 3
19.	Routh stability criterion, Relative stability analysis.	1	C		1,2,& 3
20.	Introduction to Root-Locus Techniques, The root locus concepts	1	C,D		1,2,& 3

21.	Construction of root loci.	2	C,D		1,2,& 3
22.	Introduction to lead, lag and lead-lag compensating networks	2	C,D		1,2,& 3
23.	compensator design with Root locus.	2	C,D		1,2,& 3
24.	Illustrative examples.	1	C,D		1,2,& 3
	UNIT-IV Frequency domain analysis and stability	**11**			
25.	Correlation between time and frequency response, Introduction to polar and inverse polar plots,	2	C		1,2,& 3
26.	NY Quist stability criterion.	1	C,D		1,2,& 3
27.	Assessment of relative stability gain margin and phase margin.	2	C,D		1,2,& 3
28.	Bode Plots.	1	C,D		1,2,& 3
29.	Determination of stability with Bode plots, Experimental determination of transfer function.	2	C,D		1,2,& 3
30.	Compensator design with Bode plots.	2	C,D		1,2,& 3
31.	Illustrative examples.	1	C		1,2,& 3
	UNIT – V Controller Design	**6**			

32.	Introduction to Controllers, Properties of Controller.	1	C,D		1,2,& 3
33.	Classification of Controllers, Proportional Control Mode, Integral Control Mode, Derivative Control Mode.	1	C,D		1,2,& 3
34.	Proportional-integral (PI) controller.	1	C,D		1,2,& 3
35.	Proportional-derivative (PD) controller.	1	C,D		1,2,& 3
36.	Proportional-integral- derivative (PID) controller	1	C,D		1,2,& 3
37.	Tuning rules of Ziegler-Nichols method, Illustrative examples.	1	C,D		1,2,& 3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
a	Norman S. Nise, Control Systems Engineering, 6th Edition, John Wiley & Sons Inc , 2010.
b.	M Gopal, Control Systems: Principles and Design, McGraw Hill Education; 4 Edition, 2012.
c.	K. Ogata, Modern Control Engineering, Prentice Hall India, 2006

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-II	**Total**
	Weightage	15%	15%	10%	10%	**50%**
End semester examination Weightage : 50%						**50%**

EEE 203 L	Control Systems Lab			L	T	P	C
				0	0	2	1
Co-requisite:	Control Systems (EEE 203)						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category		Core	Engineering				
Course designed by	Department of EEE						
Approval							

PURPOSE	To provide in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers based on stability and performance requirements.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To model, analysis and design of linear feedback control systems.							
2.	To analyze the time response of first and second order systems							
3.	To investigate the stability of closed loop systems							
4.	To understand the frequency response approaches for the analysis of linear time invariant (LTI) systems							
5.	To discuss basic aspects of PID controller design							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Time response of Second order system	2			1,2
2.	Effect of P, PD, PI, PID Controller on a second order systems	2			1,2

3.	Lag and lead compensation – Magnitude and phase plot	2			1,2
4.	DC position control system	2			1,2
5.	Transfer function of DC motor	2			1,2
6.	Temperature controller using PID	2			1,2
7.	Characteristics of DC servo motor	3			1,2
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
a	Norman S. Nise, Control Systems Engineering, 6th Edition, John Wiley & Sons Inc , 2010.
b.	M Gopal, Control Systems: Principles and Design, McGraw Hill Education; 4 Edition, 2012.
c.	K. Ogata, Modern Control Engineering, Prentice Hall India, 2006

EEE-204	DC Machines and Transformers	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	Introduction to Electrical Engineering (EE 101)/ Electrical Circuit Analysis(EE 202)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department OF Electrical and Electronics Engineering				
Approval					

PURPOSE	The purpose of the course is to enable the students to understand the characteristics of DC Machines and analyze their performance under different testing conditions.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the construction and working principle of DC machines							
b.	Understand the armature reaction and commutation in DC machines							
c.	Distinguish different types and identify DC machine for a given application							
d.	Test performance of different DC machines.							
e.	Understand the operation of single-phase transformer and voltage regulation.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I CONSTRUCTION, WORKING OF D.C. GENERATORS AND EXCITATION METHODS	**9**			1 to 5
1.	D.C. Generators - Constructional details, Principle of operation	2			
2.	Action of commutator; Design of armature windings types - lap and wave windings, parallel paths for lap and wave winding;	4			
3.	E.M.F equation - Problems; Methods of excitation of generators - Separately excited and self-excited; Causes of failure to self-excitation and remedial measures.	3			
	UNIT-II TYPES OF D.C. GENERATORS, ARMATURE REACTION AND COMMUTATION	**9**			1 to 5
4.	Types of generators - Shunt, Series and compound, Problems;	2			
5.	Armature reaction - Effect of armature reaction, Cross magnetizing and demagnetizing AT/pole, Compensating winding, Interpoles;	4			
6.	Commutation process, Methods to improve commutation.	3			
	UNIT- III CHARACTERISTICS OF D.C. GENERATORS, WORKING OF D.C. MOTORS, TYPES, AND STARTERS.	**9**			1 to 5

7.	Build-up of E.M.F under no load, Critical field resistance and critical speed,	1			
8.	Internal and external characteristics of shunt, Series and compound generators	3			
9.	Principle of operation DC Motor, Back E.M.F, Torque equation.	2			
10.	Starting of DC motors - Necessity and types of starters, 3 point and 4 point starters;	3			
	UNIT-IV CHARACTERISTICS OF DC MACHINES	**9**			1 to 5
11.	Characteristics of shunt, Series and compound motors	3			
12.	Types of losses - Constant and Variable losses; Calculation of efficiency - Condition for maximum efficiency and power; problems	3			
13.	Swinburne's test, Hopkinson's test, Field's test and problems	3			
	UNIT – V SINGLE PHASE TRANSFORMERS	**9**			1 to 5
14.	Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Magnetic circuits, Magnetic circuits with air gap.	2			
15.	Constructional features and principle of operation, Concept of ideal transformer, Types and operation of single phase transformer under no load and loaded conditions	2			
15.	Minimization of eddy current and hysteresis losses, Equivalent circuit, Practical transformer rating,	2			
16.	Voltage regulation - Definition and importance, Derivation of expression. problems	3			
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013
2.	A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004
3.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002
4.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011
5.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-I	CLA-II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE 204 L	DC Machines and Transformers Lab			L	T	P	C
				0	0	2	1
Co-requisite:	DC Machines and Transformers						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category		Core	Engineering				
Course designed by	Department of EEE						
Approval							

PURPOSE	The purpose of the course is to enable the students to understand the characteristics of DC Machines and analyze their performance under different testing conditions.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the construction and working principle of DC machines							
b.	Understand the armature reaction and commutation in DC machines							
c.	Distinguish different types and identify DC machine for a given application							
d.	Test performance of different DC machines.							
e.	Understand the operation of single-phase transformer and voltage regulation.							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.	1			1,2
2.	Load test on separately excited DC generator	1			1,2
3.	To study the characteristics of a dc shunt motor	1			1,2
4.	Speed Control of DC Motor: Field control, Armature control	2			1,2
5.	Swinburne's test and separation of losses in DC Machine	2			3,4
6.	Brake test on DC shunt motor. Determination of performance curves	1			3,4

8.	Hopkinson's test on DC shunt machines	1			3,4
9.	OC & SC test on single phase transformer	2			3,4
10.	Sumpner's test on single phase transformer	2			3,4
11.	Load test on single-phase transformers	2			3,4
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013
2.	A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004
3.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002
4.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011
5.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010

ECE 221	Analog Electronics	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Electronic Circuits				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Science				
Course designed by	Department of ECE				
Approval					

PURPOSE	To give the idea about fundamental properties of analog circuits and systems. To prepare students to perform the analysis of any analog electronic circuit. To empower students to understand the design and working of BJT/MOSFET amplifiers, oscillators and operational amplifiers. To prepare students for advanced courses in communication system circuit design.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Develop the ability to understand, analyze and design practical circuits based on BJT and MOSFETs.							
2.	Able to design amplifier circuits using MOSFET and BJT also will be able to understand the frequency response of the amplifiers.							
3.	Understand the effect of positive and negative feedback on different parameters of amplifiers.							
4.	Develop the skill to design, build and trouble shoot practical analog circuits which are building blocks of all modern analog and Mixed signal ICs							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Feedback Amplifiers.	**9**			
1.	General Feedback structure.	2	C		1,2
2.	Negative feedback.	2	C		1,2
3.	Feedback amplifier types.	2	C		1,2
4.	Stability problem.	2	C		1,2
5.	Frequency compensation.	2	C		1,2
	UNIT II: Signal Generators and waveform shaping circuits	**6**			1,2
6.	Basic principles of sinusoidal oscillators.	2	C-D		1,2
7.	Op-amp RC oscillator.	2	C-D-I		1,2
8.	Wein Bridge oscillator.	1	C-D-I		1,2
9.	MOSFET Crystal oscillators.	1	C		1,2
10.	Bistable multivibrators.	2	C		1,2
11.	555 timer IC and applications.	2	C-D		1,2
	UNIT – III: Active Filters and Tuned Amplifiers	**9**			1,2

12.	Filter Transmission, Types and specifications.	2	C-D-I		1,2
13.	Filter Transfer function.	1	C-D-I		1,2
14.	Butterworth and Chebyshev filters	2	C-D-I		1,2
15.	First order and second order Filter functions.	1	C-D-I		1,2
16.	SC filters, Gm-C filters.	2	C-D-I		1,2
17.	Tuned Amplifiers.	1	C-D-I		1,2
	UNIT – IV: Output stages and Power Amplifiers	**9**			1,2
18.	Classification of output stages.	2	C-D-I		1,2
19.	Class A output stage.	1	C-D-I		1,2,3
20.	Class B output stage.	2	C-D-I		1,2,3
21.	Class C output stage.	2	C-D-I		1,2,3
22.	Class D power amplifiers.	2	C-D-I		1,2,3
	UNIT – V: Voltage Reference Circuits and Data Converters	**9**			1,2,3
23.	Voltage reference circuits; Power supplies: ripple removal and regulation.	5	C-D-I		1,2,3
24.	Data converters: sample and hold circuits, ADCs and DACs	4	C-D-I		1,2,3
	Total contact hours	**46**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Microelectronic Circuits: Theory and Applications, Adel S. Sedra and K . C. Smith, 7th edition, Oxford University Press.
2.	Bezhad Rizavi *"Fundamentals of Microelectronics"*, Wiley, (2006)
3.	Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill
4.	Education Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In- semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Project	**Total**
	Weightage	**15 %**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50 %						**50%**

ECE 221 L	Analog Electronics Lab	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	Electronic Circuits				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of ECE				
Approval					

PURPOSE	To give the idea about fundamental properties of analog circuits and systems. To prepare students to perform the analysis of any analog electronic circuit. To empower students to understand the design and working of BJT/MOSFET amplifiers, oscillators and operational amplifiers. To prepare students for advanced courses in communication system circuit design.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Develop the ability to understand, analyze and design practical circuits based on BJT and MOSFETs.							
2.	Able to design amplifier circuits using MOSFET and BJT also will be able to understand the frequency response of the amplifiers.							
3.	Understand the effect of positive and negative feedback on different parameters of amplifiers.							
4.	Develop the skill to design, build and trouble shoot practical analog circuits which are building blocks of all modern analog and Mixed signal ICs and students will have hands with Multisim and/or Cadence tools for design and analysis.							

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Analysis of Feedback circuits with Op-amps.	1	C-D-I-O		1,2,3
2.	Analysis of Feedback circuits with MOSFETs.	1	C-D-I-O		1,2,3
3.	Design and Analysis of RC phase shift, LC oscillators.	2	C-D-I-O		1,2,3
4.	Design and Analysis of Wien Bridge oscillator.	1	C-D-I-O		1,2,3
5.	Design and Analysis of 555 timer based Astable and Monostable Multivibrators.	2	C-D-I-O		1,2,3
6.	Design and Analysis of MOSFET based Class A, Class B, Class AB Power amplifier.	1	C-D-I-O		1,2,3
7.	Design and Analysis of Op-amp based Active filters.	1	C-D-I-O		1,2,3
8.	Design and Analysis of Voltage regulator circuits.	1	C-D-I-O		1,2,3
9.	Design and Analysis of Voltage reference circuits.	1	C-D-I-O		1,2,3
10.	Design and Analysis of ADCs, DACs-I.	2	C-D-I-O		1,2,3

11.	Design and Analysis of ADCs, DACs-II.	1	C-D-I-O		1,2,3
12.	Course project	3	C-D-I-O		1,2,3
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Microelectronic Circuits: Theory and Applications, Adel S. Sedra and K . C. Smith, 7th edition, Oxford University Press.
2.	Bezhad Rizavi *"Fundamentals of Microelectronics"*, Wiley, (2006)
3.	Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill
4.	Education Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson

Course nature				**Theory**		
Assessment Method – Practical Component (Weightage 100%)						
In- semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz 1	Quiz 2	**Total**
	Weightage	**15 %**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

MAT-211	Linear Algebra	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Basic Sciences				
Course designed by	Department of Mathematics				
Approval					

PURPOSE	The main aim of this course is to make students understand the central ideas of linear algebra like solving linear equations performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering							
b.	The main aim of this course is to make students understand the central ideas of linear algebra like solving linear equations							
c.	performing matrix algebra, calculating determinants, finding eigenvalues and eigenvectors							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I - Matrices and Gaussian elimination	**9**			
1.	Introduction, Geometry of Linear Equations	2	C		1
2.	Gaussian Elimination	2	C		1
3.	Matrix Notation and Matrix Multiplication	2	C		1
4.	Triangular Factors and Row Exchanges	2	C		1
5.	Inverses and Transposes	1	C		1
	Unit II - Vector spaces	**9**			
6.	Vector spaces and Subspaces	2	C		1
7.	Solving Ax = 0 and Ax = b	2	C		1
8.	Linear Independence, Basis and Dimension	2	C		1
9.	The Four Fundamental Subspaces	2	C		1
10.	Graphs and Networks, Linear Transformations	1	C		1

	Unit III - Orthogonality	**9**			
11.	Orthogonal Vectors and Subspaces	2	C		1
12.	Cosines and Projections onto Lines	2	C		1
13.	Projections and Least Squares	2	C		1
14.	Orthogonal Bases and Gram-Schmidt	3	C		1
	Unit IV - Determinants	**9**			
15.	Introduction	3	C		1
16.	Properties of the Determinant	2	C		1
17.	Formulas for the Determinant	2	C		1
18.	Applications of Determinants	2	C		1
	Unit V - Eigenvalues and eigenvectors	**9**			
19.	Introduction, Diagonalization of a Matrix	3	C		1
20.	Difference Equations and Powers A^k	2	C		1
21.	Differential Equations and e^{At}	2	C		1
22.	Complex Matrices, Similarity Transformations.	2	C		1

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Gilbert Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007
2.	S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
3.	K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

ENG 105 L	Engineering Graphics: LABORATORY	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Mechanical Engineering				
Approval					

PURPOSE	The course provides the fundamentals of engineering drawing. Topics include: orthographic projection, dimensioning, sectioning, exploded and auxiliary views, assembly drawings, and CAD Design software.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Understand basic 2-D sketching							
2.	Parametric solid modelling							
3.	Production of 3D models from 2D sketches							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	2-D sketching with geometrical and dimensional constraints.	2	D-I-O		1, 2
2.	Tool introduction on parametric solid modelling of a machine component	2	D-I-O		1, 2
3.	Solid modelling of the parts of a machine (Exercise No: 1-5)	2	D-I-O		1, 2
4.	Solid modelling of the parts of a machine (Exercise No: 5-10)	2	D-I-O		1, 2
5.	Solid modelling of the parts of a machine (Exercise No: 10-15)	2	D-I-O		1, 2
6.	Solid modelling of the parts of a machine (Exercise No: 15-20)	2	D-I-O		1, 2
7.	Solid modelling of the parts of a machine (Exercise No: 20-25)	2	D-I-O		1, 2
8.	Solid modelling of the parts of a machine (Exercise No: 25-30)	2	D-I-O		1, 2
9.	Assembly modelling of the parts modelled in assignment 3 using proper mating conditions and generation of exploded view.	2	D-I-O		1, 2
10.	Generation of production drawings	2	D-I-O		1, 2
	Total contact hours (Including demo and repeat labs)	**20**			

LEARNING RESOURCES

	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Bhatt, N.D, Engineering Drawing, Charotar Publishers, 2014
2.	Bhatt, N.D, Machine Drawing, Charotar Publishers, 2014
3.	Venugopal, K. and Prabhu Raja, V., Engineering Graphics, Eighth Edition (Revised), New Age International Publishers, Chennai, 2007.

Course nature			**Practical**	
Practical	**Assessment Tool**	**Conducting Marks**	**Converting Marks**	**Final Conversion**
Internal	Assignment	30	30	60%
	Lab Exercise	30	30	
End Semester Exam	Final Exam +Viva Voce	40	40	40%
TOTAL			100	100%

ISES 212	Industry Specific Employability Skills IV	L	T	P	C
		1	1	0	1
Co-requisite:	Nil				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Skill Building				
Course designed by	Department of Career Development Centre				
Approval					

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	An ability to apply knowledge of mathematics, science and engineering.							
b.	An ability to function on multidisciplinary teams.							
c.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic.							
d.	Build vocabulary through methodical approaches and nurture passion for learning new words.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**8**			
1.	Permutation and Combination, Probability.	4	C and I		1
2.	Geometry, and Algebra.	4	C and I		1
	UNIT-II	**6**			
3.	Clocks, Calendars and Blood Relations.	3	C and I		1
4.	Arrangements, Cubes and Syllogism.	3	C and I		1,2
	UNIT- III : CRITICAL REASONING	4			
5.	Introduction to Different Parts of an Argument in Reasoning , Assumption of an Argument.	2	C and I		1
6.	Strengthening of an Argument, Weakening of an argument.	2	C and I		2
7.	Para jumbles.	2	C and I		2
	UNIT-IV: Verbal reasoning	6			
8.	Word Analogy.	2	C and I		3,4
9.	Sentence Completion & Text Completion.	2	C and I		3,4
10.	Sentence Equivalence.	2	C and I		3,4

	UNIT-V	6			
11.	Reading Comprehension.	3	C and I		5,6,7
12.	Identification of errors, Sentence correction.	3	C and I		5,6,7
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2.	RsAgarwal,A Modern Approach to Verbal and Non Verbal Reasoning,S.Chand Publications.
3.	Verbal Ability and Reading comprehension-Sharma and Upadhyay.
4.	Manhattan GMAT Sentence Correction Guide, 5th Edition.
5.	R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning. S.Chand Publications.
7.	The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA 1	CLA 2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

CSE 330	Industry Standard Coding Practice - 2	L	T	P	C
		0	0	4	1
Co-requisite:	Computer Lab				
Prerequisite:	ISCP - 01				
Data Book / Codes/Standards	Listed in Reference				
Course Category	Engineering Sciences				
Course designed by	As per Industry Norms by CCC				
Approval					

PURPOSE	The purpose of this course is bridging the gap between industry and academia, through enabling students on application of problem solving and competitive coding skills irrespective of languages of their choice.

LEARNING OBJECTIVES	
At the end of the course, student will be able to	
a.	Understand importance of mathematics and problem-solving approaches for programming
b.	Understand importance of optimized solutions for problems solving and its relevance to industry.
c.	Implement mathematical and logical understanding approaches to implement test driven development practices.
d.	Start participating in global coding competitions relevant to the syllabus

STUDENT OUTCOMES	
1.	Able to understand test and development aspects of programming by solving problems at Industry standards.
2.	Able to interpret any given problem using required domain skills, mathematics.
3.	Able to learn applicable methods to optimize solutions for any given problem.
4.	Able to develop programs using C / any language with data structures.
5.	Able to develop OOP programs through Java with test driven development.
6.	Able to learn and implement database concepts required for placements.

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**8**			
1.	Problems Solving with: Structure Pointers, formation of links, Operations on Linked lists, Operations on a circular linked list, Operations on a double linked list & Industry Standard Practice Questions.				1
	UNIT- II	**8**			
2.	Problem Solving with - Stack Operations, Queue data stru Implementation, Linear / Binary Search Algorithms, Sorting Algorithms, Industry Standard Practice Questions.				1,2
	UNIT-III	**8**			

3.	Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.				1
	UNIT-IV	**12**			
4.	Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms & Industry Standard Practice Questions.				1,2
	UNIT-V	**12**			
5.	Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.				3,4,5
	Total contact hours	48			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Fundamentals of Data Structures in C++ - 2e- Sahni Horowitz - Universities Press
2.	Algorithms -4e- Robert Sedgewick & Kevin Wayne - Addison-Wesley Professional
3.	C++ Standard Library A Tutorial and Reference – 2e - Nicolai M. Josuttis - Addison Wesley Longman
4.	An Introduction to Database Systems – 8e - C.J. Date – Pearson
5.	Competitive Programming – 3e – Steven Halim, Felix Halim

Course nature				**Theory & Practical's**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term test I	Mid Term test II	Quiz	Assignment	**Total**
	Weightage	**25%**	**25%**	-	-	**100%**
End semester examination Weightage : 50%						

SEMESTER V

EEE 301	AC Machines	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	Magnetic circuits, Three-phase transformers				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	The purpose of the course is to understand the construction, operation and make performance analysis of transformers and 3-phase induction motors by conducting suitable tests.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the operation of transformers and induction motors.							
b.	Perform suitable tests on transformers to analyze the characteristics							
c.	Perform suitable tests on induction motors to analyze the characteristics							
d.	Understand different starting methods of three phase induction motors.							
e.	Understand different speed control techniques of three phase induction motors.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I PERFORMANCE AND EQUIVALENT CIRCUIT ANALYSIS OF SINGLE PHASE TRANSFORMERS	**10**			
1.	Brief review of transformer operation and equivalent circuit, Losses and efficiency, Condition for maximum efficiency, All-day efficiency, Effect of variation of frequency and supply voltage on iron losses; problems.	3			3&4
2.	O.C. and S.C. tests, Sumpner's test, Determination of equivalent circuit parameters; problems.	2			3&4
3.	Per-unit, Parallel operation with equal and unequal voltage ratios; problems.	3			3&4
4.	Autotransformer - Principle of operation, Advantages and disadvantages over a two winding transformer.	2			3&4
	UNIT-II THREE PHASE TRANSFORMERS	**8**			
5.	Constructional details, Different connections of phasor groups, Unbalanced operation of three phase transformers.	2			3&4
6.	Parallel operation of three phase transformer, all day efficiency; Problems.	2			3&4
7.	auto transformers equivalent circuit - comparison with two winding transformers. Open delta or V connection,	4			3&4

	Three phase to two phase conversion (Scott Connection), Tap changing transformers; problems.				
	UNIT- III Induction Machines	**9**			
8.	Elementary balanced 3-phase distributed winding and production of revolving magnetic field, Comment on its strength, Speed and direction of rotation.	2			3&4
9.	Construction, Types (squirrel cage and slip ring), Definition of slip and its importance, Relation between s and rotor frequencies, Per phase equivalent circuit, Phasor Diagram. Relation between air gap power, Rotor copper losses and mechanical power devel	4			3&4
10.	Expression for electromagnetic torque developed, Expressions for starting and maximum torque, Torque slip characteristic - For supply voltage, Rotor resistance and frequency variation.	3			3&4
	UNIT-IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	**10**			
11.	Crawling and cogging, Basic principle of starting induction motor - Direct on line, Reactor, Autotransformer, Star-delta and Rotor resistance starters; problems.	5			3&4
12.	Methods of speed control – Stator voltage control, Variable frequency control; Change of poles and methods of consequent poles, Cascaded connection, Rotor resistance control and injection of emf into rotor circuit.	5			3&4
	UNIT – V Single-phase induction motors	**8**			
13.	Constructional features, double revolving field theory.	2			3&4
14.	Equivalent circuit, determination of parameters	3			3&4
15.	Split-phase starting methods and applications	3			3&4
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

5.	A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 1984.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

EEE 301 L	AC Machines Lab	L	T	P	C
		0	0	2	1
Co-requisite:	AC Machines Lab				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	The purpose of the course is to understand the construction, operation and make performance analysis of transformers and 3-phase induction motors by conducting suitable tests.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the operation of transformers and induction motors.							
b.	Perform suitable tests on transformers to analyze the characteristics							
c.	Perform suitable tests on induction motors to analyze the characteristics							
d.	Understand different starting methods of three phase induction motors.							
e.	Understand different speed control techniques of three phase induction motors.							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Brake test on 3-ph squirrel cage Induction Motor	1			
2.	Load test on 3-ph AC slip ring Induction Motor	1			
3.	Load test on 1-ph Induction motor	2			
4.	No–load & Blocked rotor tests on three phase Induction motor	2			
5.	Equivalent circuit of a single phase induction motor	1			
6.	Speed control of induction motor by V/f method	2			
7.	Power factor improvement of single phase induction motor by using capacitors and load test on single phase induction n	**1**			
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5.	A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

EEE 308	Power Electronics	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	1. Electrical Circuit Analysis (EE 202) / Electrical Technology (EEE 211) 2. Differential Equations (MAT 131)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To study the basic principles and operations of different power electronic converters such as dc/ac, ac/dc, ac/ac, and dc/dc.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	To learn the characteristics of different power semiconductor devices.							
b.	To understand the operation of single phase and three phase full-wave ac/dc converters.							
c.	To study the operation of different types of DC-DC converters.							
d.	To understand the operation of single phase and three phase inverters.							
e.	To study the operation of AC-AC Regulators.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I: Power Semi-Conductor Devices	**9**			
1.	Thyristors–Silicon controlled rectifiers (SCR's) – Characteristics of power MOSFET and power IGBT.	3	C		1&2
2.	Basic theory of operation of SCR–Static characteristics– Turn on and turn off methods.	2	C		1&2
3.	Dynamic characteristics of SCR– Snubber circuit design.	2	C		1&2
4.	Basic requirements of gating circuits for SCR, IGBT and MOSFET.	2	C		1&2
	UNIT-II: AC-DC Converters	**9**			
5.	1-phase half wave and full wave-controlled rectifiers – R load and RL load with and without freewheeling diode –continuous and discontinuous conduction.	3	C		1&2
6.	Effect of source inductance in 1-phase fully controlled bridge rectifier with continuous conduction.	2	C		1&2

7.	3-phase half wave-controlled rectifier with R and RL load.	2	C		1&2
8.	3-phase semi controlled rectifier with R and RL load.	1	C		1&2
9.	3-phase fully controlled rectifier with R and RL load.	1	C		1&2
	UNIT- III: DC–DC Converters	**9**			
10.	Analysis of Buck, boost and buck, buck-boost conver Continuous Conduction Mode (CCM).	3	C		1&2
11.	Output voltage equations using volt-sec balance in CCM & DCM output voltage ripple & inductor current.	3	C		1&2
12.	Ripple for CCM only – Principle of operation of forward and fly back converters in CCM.	3	C		1&2
	UNIT- IV: DC–AC Converters	**9**			
13.	1- phase half bridge and full bridge inverters with R and RL loads.	2	C		1&2
14.	3-phase square wave inverters – 120^0 conduction and 180^0 conduction modes of operation.	2	C		1&2
15.	PWM inverters – Quasi-square wave pulse width modulation – Sinusoidal pulse width modulation.	3	C		1&2
16.	Prevention of shoot through fault in Voltage Source Inverter (VSI) – Current Source Inverter (CSI).	2	C		1&2
	UNIT- V: AC – AC Regulators	**9**			
17.	Static V-I characteristics of TRIAC and modes of operation.	2	C		1&2
18.	1-phase AC-AC regulator phase angle control and integrated cycle control with R and RL load.	3	C		1&2
19.	For continuous and discontinuous conduction- 3-Phase AC-AC regulators with R load only.	2	C		1&2
20.	Transformer tap changing using antiparallel Thyristors.	2	C		1&2
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a].	Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
2[a].	Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3[b].	Power Electronics: Essentials & Applications by L. Umanand, Wiley, Pvt. Limited, India, 2009.

4^{b}.	Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE 308 L	Power Electronics Laboratory	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	1. Electrical Circuit Analysis (EE 202) / Electrical Technology (EEE 211) 2. Differential Equations (MAT 131)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To study the basic principles and operations of different power electronic converters such as dc/ac, ac/dc, ac/ac, and dc/dc.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Study the characteristics of power semiconductor devices.							
b.	Analyze the different converters output waveforms for R and RL loads.							
c.	Design and conduct simulation and experiments on Rectifiers, Choppers, AC voltage controller, Inverter circuits.							

S. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Study V-I characteristics of SCR and measure latching and holding currents.	2	I, O		1&2
2.	Study V-I characteristics of MOSFET and IGBT.	2	I, O		1&2
3.	Characteristics of Single-Phase Half Controlled Full-Bridge Rectifier.	2	I, O		1&2
4.	Characteristics of Single-Phase Fully Controlled Full-Bridge Rectifier.	2	I, O		1&2
5.	Characteristics of Three-Phase semi controlled Rectifier.	2	I, O		1&2
6.	Characteristics of Three-Phase full controlled Rectifier.	2	I, O		1&2
7.	Study of Single-Phase AC Voltage Controller using TRIAC.	2	I, O		1&2
8.	Study of characteristics for characteristics of DC-DC buck converter.	2	I, O		1&2
9.	Study of characteristics for characteristics of DC-DC boost converter.	2	I, O		1&2
10.	Study of unipolar and bi-polar PWM based single-phase inverter.	2	I, O		1&2

11.	Study of 3-Phase PWM & non-PWM inverter.	2	I, O		1&2
12.	Closed loop implementation of buck and boost converter with voltage mode control.	2	I, O		1&2
	Total contact hours	**24**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a].	Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
2[a].	Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3[b].	Power Electronics: Essentials & Applications by L. Umanand, Wiley, Pvt. Limited, India, 2009.
4[b].	Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, New Age International (P) Limited Publishers, 1996.

Course nature				**Practical**	
Assessment Method – Practical Component (Weightage 100%)					
In-semester	**Assessment tool**	Lab performance	Practical model exam	Observation note	**Total**
	Weightage	**20%**	**20%**	**10%**	**50%**
End semester examination Weightage: 50%					**50%**

EEE 304	Fundamentals of Power Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Fundamentals of Electrical Engineering (EEE 101)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To introduce the students to different electrical and mechanical aspects of the power network

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Know the different elements of electric power supply							

	system							
b.	Understand the constructional features of different types of overhead lines and insulators							
c.	Understand the constructional features of different types of underground cables							
d.	Learn the computation of transmission line resistance, inductance, and capacitance							
e.	Know about the DC and AC distribution systems							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Supply Systems	9			
1.	Electric supply system, Typical AC power supply Scheme, Comparison of DC and AC transmission, Advantages of high transmission voltage.	2			3
2.	Various system of power transmission, Comparison of conductor material in overhead system.	2			3
3.	Comparison of conductor material in underground system, Comparison of various systems of transmission.	2			3

4.	Elements of a transmission line, Economics of power transmission, Economic choice of conductor size.	2			3
5.	Economic choice of transmission voltage, Requirement of satisfactory electric supply.	1			3
	UNIT-II Mechanical Design of Overhead Lines	9			
6.	Main components of overhead lines, Conductor materials, Line supports.	2			2, 3, 4
7.	Insulators, Types of insulators, Potential distribution over suspension insulators.	2			2, 3, 4
8.	String efficiency, Methods of improving string efficiency, Sag in overhead lines, Calculation of sag.	2			2, 3, 4
9.	Corona, Factors affecting corona, Advantages and disadvantages of corona.	2			2, 3, 4
10.	Methods of reducing corona effect.	1			2, 3, 4
	UNIT – III Underground cables	9			
11.	Underground cables, Construction of cables, Insulating materials for cables, Classification of cables.	1			3, 4

12.	Cables for three-phase service, Laying of underground cables, Insulation resistance of a single-core cable.	2			3, 4
13.	Capacitance of a single-core cable, Dielectric stresses in a single-core cable.	2			3, 4
14.	Most economical conductor size in a cable, Grading of cables, Capacitance grading, Inters heath grading.	2			3, 4
15.	Capacitance of 3-core cables, Measurements of core to core capacitance (Cc) and core to earth capacitance (Ce).	2			3, 4
	UNIT- IV : Computation of Line parameters	9			
16.	Different types of line conductors, Computation of line resistance, Effect of temperature and skin effect on the line resistance.	1			1, 2, 3, 4
17.	Inductance due to internal flux linkage, Inductance due to external flux linkage, Computation of inductance of single-phase lines, Flux linkages of one conductor in a group	2			1, 2, 3, 4
18.	Inductance of composite conductor lines, Computation of inductance of three-phase lines with symmetrical and asymmetrical spacing's.	1			1, 2, 3, 4
19.	Inductance of transposed lines, Computation of inductance for bundled conductors, Inductance of three-phase double circuit lines.	1			1, 2, 3, 4

20.	Electric field of a long straight conductor, Potential difference between two points due to a charge.	1			1, 2, 3, 4
21.	Computation of line capacitance of single-phase lines, Potential difference in a multi-conductor configuration.	1			1, 2, 3, 4
22.	Capacitance of three-phase lines with symmetrical and asymmetrical spacings.	1			1, 2, 3, 4
23.	Effect of earth on the capacitance, Computation of capacitance for bundled conductors.	1			1, 2, 3, 4
	UNIT-V Distribution Systems- DC and AC distribution.	9			
24.	Distribution system, Classification of distribution systems, AC distribution, DC distribution, Connection schemes of distribution system.	2			3, 4
25.	Types of DC distributors, DC distribution calculations, DC distributor fed at one end- concentrated loading, Uniformly loaded distributor fed at one end.	2			3, 4
26.	Distributor fed at both ends- concentrated loading, Uniformly loaded distributor fed at both ends, Distributor with both concentrated and uniform loading, Ring distributor, Ring main distributors with interconnector.	2			3, 4
27.	AC distribution calculations, Methods of solving AC distribution problems.	2			3, 4
28.	3-phase unbalanced loads, Four-wire star-	1			3, 4

	connected unbalanced loads, Ground detectors.				
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS {T}/ REFERENCE BOOKS {R}
1.	Power Systems Analysis: John J. Grainger and W. D. Stevenson, Jr., McGraw-Hill, Inc., 1994. {R}
2.	Electrical Power systems: C. L. Wadhwa, 6th Edition, New Age International Publishers. {R}
3.	Principles of Power System: V.K. Mehta and Rohit Mehta, 4th Revised Edition, S. Chand. {T}
4.	Power System Engineering: D.P. Kothari and I.J. Nagrath, Second Edition, McGraw-Hill. {T}

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	Assessment tool	Cycle test I	Cycle test II	CLA 1	CLA 2	Total

	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: **50%**						**50%**

EEE 305	Advanced Control Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Differential Equations (MAT 131), Linear Algebra (MAT 211), Control Systems (EEE 203)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To make students learn beyond conventional control systems, and to make them understand about various nonlinearities present in physical systems, thereby helping them combat the stability issue, criterion for controllability & observability, state space approach for trajectory tracking and finally nonlinear controller design methods**.**

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Discuss state variable approach for linear time invariant systems in continuous time domain. Discuss state variable approach for linear time invariant systems in continuous time domain.							
2.	Develop state models for linear continuous time systems.							

3.	Apply vector and matrix algebra to find the solution of state equations for linear continuous time systems.							
4.	Define controllability and observability of a system and test for controllability and observability of a given system. Design pole assignment and state observer using state feedback.							
5.	Develop the describing function for the nonlinearity present to assess the stability of the system. Develop Lyapunov function for the stability analysis of nonlinear systems.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I State Variable Analysis and Design	**13**			1,2,& 3
1.	Review of classical control system.	2	C		1,2,& 3
2.	Analysis in state-space: A perspective on state-space design.	1	C		1,2,& 3
3.	State variables, State models for physical systems.	1	C		1,2,& 3
4.	SISO and MIMO systems.	1	C		1,2,& 3
5.	Solution of state equations. Transfer function.	1	C		1,2,& 3

6.	Eigenvalues and eigenvectors.	1	C		1,2,& 3
7.	Jacobian linearization technique.	1	C		1,2,& 3
8.	State transformations and diagonalization.	1	C		1,2,& 3
9.	Transformation to phase-variable canonical form.	1	C		1,2,& 3
10.	Controllability and observability.	1	C		1,2,& 3
11.	Duality property.	1	C		1,2,& 3
12.	Illustrative Problems	1	C, D		1,2 & 3
	UNIT-II Pole Placement Design and State Observers	**6**			1,2,& 3
13.	Introduction	1	C,D		1,2,& 3
14.	Stability Improvements by State Feedback	1	C,D		1,2,& 3
15.	Necessary and Sufficient Conditions for Arbitrary Pole Placement.	1	C,D		1,2,& 3
16.	State Regulator Design	1	C,D		1,2,& 3
17.	Design of State Observer.	1	C,D		1,2,& 3

18.	Compensator Design by the Separation Principle.	1	C,D		1,2,& 3
	UNIT- III Non-linear Systems Analysis	**8**			
19.	Common Nonlinear System Behaviours.	1	C		1,2,& 3
20.	Common Nonlinearities in Control Systems.	1	C,D		1,2,& 3
21.	Describing Functions of Common Nonlinearities.	1	C,D		1,2,& 3
22.	Stability Analysis by Describing Function Method.	2	C,D		1,2,& 3
23.	Concept of Phase Plane Analysis.	1	C,D		1,2,& 3
24.	Construction of Phase Portraits, System Analysis on the Phase Plane.	1	C,D		1,2,& 3
25.	Variable Structure Systems.	1			
	UNIT-IV Lyapunov's Stability Analysis	**5**			
26.	Introduction	1	C		1,2,& 3
27.	Lyapunov's Stability Criteria	1	C,D		1,2,& 3
28.	The direct method of Lyapunov stability.	1	C,D		1,2,& 3

29.	Methods of constructing Lyapunov Function for Non-linear Systems.	1	C,D		1,2,& 3
30.	Illustrative examples.	1	C,D		1,2,& 3
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
a.	"Modern Control Engineering," K.Ogata, Pearson Education Asia/ PHI,4 th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
b..	Control Systems Engineering (For the Modules 1 and 2) I.J. Nagarath and M.Gopal New Age 5 th Edition, 2007.
c.	Nonlinear Control, Hassan K. Khalil Pearson Education Limited, 2015.

Course nature			**Theory**		
Assessment Method (Weightage 100%)					
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-II	**Total**
	Weightage	15%	15%	10%	10%	**50%**
End semester examination Weightage : 50%					**50%**

EEE 305 L	Advanced Control Systems Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Advanced Control Systems (EEE 305)				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To make students learn beyond conventional control systems, and to make them understand about various nonlinearities present in physical systems, thereby helping them combat the stability issue, criterion for controllability & observability, state space approach for trajectory tracking and finally nonlinear controller design methods**.**

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Discuss state variable approach for linear time invariant systems in continuous time domain. Discuss state variable approach for linear time invariant systems in continuous time domain.							
2.	Develop state models for linear continuous time systems.							

3.	Apply vector and matrix algebra to find the solution of state equations for linear continuous time systems.							
4.	Define controllability and observability of a system and test for controllability and observability of a given system. Design pole assignment and state observer using state feedback.							
5.	Develop the describing function for the nonlinearity present to assess the stability of the system. Develop Lyapunov function for the stability analysis of nonlinear systems.							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	DC Motor modeling using LabVIEW	1			1&2
2.	Speed control of DC Motor	1			1&2
3.	Position control of DC Motor	1			1&2
4.	Inverted pendulum control	2			1&2
5.	Characteristics of Brushed and Brushless DC motor	2			2&3
6.	Speed control of stepper motor	1			2&3
7.	Position control of servo motor	1			2&3
8.	Tuning of PID controller gains for closed loop converter control	2			2&3
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
a.	"Modern Control Engineering," K.Ogata, Pearson Education Asia/ PHI,4 th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
b..	Control Systems Engineering (For the Modules 1 and 2) I.J. Nagarath and M.Gopal New Age 5 th Edition, 2007.
c.	Nonlinear Control, Hassan K. Khalil Pearson Education Limited, 2015.

EEE 302	Numerical Methods	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:					
Data Book / Codes/Standards	Approved Steam Tables, Refrigeration Tables and Psychometric Chart.				
Course Category	Engineering Sciences				
Course designed by	Department of Mechanical Engineering				
Approval					

PURPOSE	To acquire analytical ability in solving mathematical problems numerically.							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to understand								
1.	To familiarize with numerical solutions of equations.	a	e					
2.	Learn about numerical differentiations and integration.	a	e					
3.	Learn about numerical solution to ordinary differential equations.	a	e					
4.	Learn about numerical solution to partial differential equations.	a	e					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CURVE FITTING/ NUMERICALSOLUTIONS	**10**			
1.	Curve fitting, straight line, parabola.	2	C	1	1,2
2.	Newton Raphson method.	2	C,D	1	1,2
3.	Bisection method.	2	C,D	1	1,2
4.	Iterative methods.	2	C,D	1	1,2
5.	Power methods.	2	C	1	1,2
	UNIT II: - FINITE DIFFERENES AND INTEGATION	**10**			
6.	Forward difference and backward difference.	2	C	2	1,2
7.	Central difference.	2	C	2	1,2
8.	Interpolation.	2	C,D	2	1,2
9.	Divided differences.	2	C	2	1,2
10.	Inverse interpolation.	2	C,D	2	1,2
	UNIT III: NUMERICAL DIFFERENTIAION AND INTEGRATION	**8**			
11.	Numerical differentiation, applications.	2	C	3	1,2
12.	Numerical integration, applications.	2	C	3	1,2

13.	Simpsons rule.	2	C,D	3	1,2
14.	Trapezoidal rule.	2	C,D	3	1,2
	UNIT IV: NUMERICAL SOLUTIONS OF FIST ORDER ODE	**9**			
15	Taylor series method.	2	C	4	1,2
16.	Euler's methods and applications.	2	C	4	1,2
17.	Runge kurta method.	3	C,D	4	1,2
18.	Predictor corrector method.	2	C	4	1,2
	UNIT V: NUMERICAL SOLUTION OF PDE	**7**			
19.	Solution of elliptic equations.	1	C	4	1,2
20.	Solution of Laplace equations.	2	C	4	1,2
21.	Solution of parabolic equations.	2	C,D	4	1,2
22.	Solutions of hyperbolic equations.	2	C,D	4	1,2
	Total contact hours *	**45**			

*Excluding assessment hours

LEARNING RESOURCES	
Sl. No.	**TEXT BOOKS**
1.	B.S.Grewal, Numerical methods in engineering and science, Khanna publisher, 2012
2.	M.K.Venkatraman, Numerical methods in engineering, National publishing, 2005
3.	S.S.Sastri, Numerical methods analysis, 2005

Course nature			**Theory**				
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	**Mid Term I**	**Mid Term II**	**Assignment**	**Surprise Test**	**Quiz**	**Total**
	Weightage	**15%**	**15%**	**10%**	**5%**	**5%**	**50%**

ISES 311	Industry Specific Employability Skills-V	L	T	P	C
		1	1	0	0
Co-requisite:	Nil				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Skill Building				
Course designed by	Department of Career Development Centre				
Approval					

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	An ability to apply knowledge of mathematics, science and engineering							
b.	An ability to function on multidisciplinary teams							
c.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I NUMBERS	**8**			
1.	Types and Properties of Numbers and Remainders.	4	C and I		1
2.	LCM, GCD, Fractions and decimals, Surds and Progressions.	4	C and I		1
	UNIT-II	**8**			
3.	Permutations, Combinations and Probability.	4	C and I		1
4.	Data Interpretation.	4	C and I		1,3
	UNIT- III	**8**			
5.	Geometry and Coordinate Geometry.	4	C and I		1
6.	Trigonometry and Mensuration.	4	C and I		1
	UNIT-IV: Reasoning	**8**			
7.	Syllogism and Non Verbal Reasoning.	4	C and I		2, 3
8.	Analytical Reasoning.	4	C and I		2, 3
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2.	R.S Agarwal, A Modern Approach to Verbal and Non Verbal Reasoning, S.Chand Publications.
3.	Arun Sharma– How to Prepare for Data Interpretation & Logical Reasoning for the CAT.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

CSE 331	Industry Standard Coding Practice 3	L	T	P	C
		0	0	4	1
Co-requisite:	Computer Lab/ Laptop				
Prerequisite:	ISCP - 02				
Data Book / Codes/Standards	Listed in Reference				
Course Category	Engineering Sciences				
Course designed by	As per the industry norms by CCC				
Approval					

PURPOSE	The purpose of this course is bridging the gap between industry and academia, through enabling students on application of problem solving and competitive coding skills irrespective of languages of their choice.

LEARNING OBJECTIVES

At the end of the course, student will be able to

a.	Understand importance of mathematics and problem-solving approaches for programming
b.	Understand importance of optimized solutions for problems solving and its relevance to industry.
c.	Implement mathematical and logical understanding approaches to implement test driven development practices.
d.	Start participating in global coding competitions relevant to the syllabus

STUDENT OUTCOMES

1.	Able to understand test and development aspects of programming by solving problems at Industry standards.
2.	Able to interpret any given problem using required domain skills, mathematics.
3.	Able to learn applicable methods to optimize solutions for any given problem.
4.	Able to develop programs using C / any language with data structures.
5.	Able to develop programs using C, python / any preferred language until advanced algorithms with test driven development approach
6.	Able to implement problem solving using R programming

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**8**			
1.	Problem solving with - Descriptive statistics, Mean/median/mode, Measures of dispersion/range variance, deviations, mean/median/mode problems, Random variables, Univariate & Bivariate random variables				1
	UNIT- II	**10**			
2.	Problem solving with - Graphs, Handshaking Lemma, Simple Graphs, DFS/BFS, Connected components, coloring, Introduction to DAGs, Spanning Trees, Articulation Points/ Connected points				2,3,5
	UNIT-III	**12**			

3.	Problem solving with - Greedy Methods: Coin change, Fractional Knapsack, Activity Selections/ Job sequencing with Deadlines, Spanning Trees, Dynamic Programming: 0/1 Knapsack, Substructures, Longest common substring/subsequence, Longest Increasing sub sequence, Grid based Problems				2,3,5
	UNIT-IV	**10**			
4.	Problem solving with - Divide & Conquer Strategies: Quick/Merge Sort, Min/Power functions, Backtracking, N Queens problem, Finding the path & Grid based problems, iterative/loop free approaches				2,3,5
	UNIT-V	**8**			
5.	R Language Constructs, calculations, Operators, vectors, lists, Practice problems implementing R language, Matrices and data frame, Conditional statements and loops, Problem Solving on R language examples				
	Total contact hours	**48**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	An Introduction to Statistical Learning: with Applications in R - Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
2.	Introduction to Algorithms by Thomas H. Corman, The MIT Press, 3rd Edition
3.	Introduction to Algorithms: A Creative Approach by Udi Mander, Pearson
4.	R Cookbook - Paul Teetor, O'reilly
5.	Competitive Programming – 3e – Steven Halim, Felix Halim

Course nature		**Theory & Practical's**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Mid Term test I	Mid Term test II	**Total**
	Weightage	**25%**	**25%**	**50%**
End semester examination Weightage : 50%				**50%**

SEMESTER VI

EEE 306	Power System Analysis	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	1. Fundamentals of Power Systems (EEE 304) 2. Numerical Methods (ME 132)				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department Of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide comprehensive knowledge on power system analysis problems.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Analyze the performance of short, medium, and long transmission lines							
2.	Use numerical methods to analyze the steady state operation of power systems							
3.	Analyze the behavior of the power system under fault conditions							
4.	Analyze the stability status of power system under transient condition							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Performance of Transmission Lines	**9**			
1.	Representation of transmission lines, Short transmission line, Medium transmission line.	2			1,2
2.	Long transmission line: solution of the differential equations, interpretation of the equations, hyperbolic form of the equations.	2			1,2
3.	The equivalent circuit of a long line, Ferranti effect, Power flow through a transmission line.	2			1,2
4.	Transmission line transients, Transient analysis: travelling waves, reflections.	2			1,2
5.	Numerical Problems.	1			1,2
	UNIT-II Power Flow Analysis	**9**			
6.	Formation of Y-bus matrix, the power flow problem.	2			1 to 5
7.	per unit quantities, Changing the base of per unit quantities, Gauss seidel method.	2			1 to 5
8.	Newton Raphson method, Newton Raphson power flow solution.	2			1 to 5
9.	Decoupled power flow, Comparison of power flow methods.	2			1 to 5
10.	Numerical problems.	1			1 to 5

	UNIT-III Symmetrical Fault Analysis	**6**			
11.	Transients in RL series circuits, Internal voltages of loaded machines under fault conditions.	2			1 to 5
12.	Fault calculation using Z-bus, Fault calculations using Z-bus equivalent circuits.	2			1 to 5
13.	Selection of circuit breakers, Numerical problems.	2			1 to 5
	UNIT-IV Unsymmetrical Fault Analysis	**12**			
14.	Synthesis of unsymmetrical phasors from their symmetrical components, The symmetrical components of unsymmetrical phasors, Power in terms of symmetrical components.	2			1 to 5
15.	Symmetrical star and delta circuits, Sequence circuits for star and delta impedances.	2			1 to 5
16.	Sequence circuits of a symmetrical transmission line, Sequence circuits of the synchronous machine.	2			1 to 5
17.	Sequence circuits of star-delta transformers, Unsymmetrical series impedances, Sequence networks.	2			1 to 5
18.	Unsymmetrical faults in power systems, Single line to ground fault, Line to line faults.	2			1 to 5
19.	Double line to ground faults, Open conductor faults, Numerical problems.	2			1 to 5
	UNIT-V Power System Stability	**9**			
20.	The stability problem, Rotor dynamics and the swing equation.	2			1 to 5
21.	The power angle equation, Synchronizing power coefficients, Equal-area criterion of stability.	2			1 to 5
22.	Applications of the equal-area criterion, Multimachine stability studies.	2			1 to 5
23.	Solution of the swing curve, Factors affecting transient stability.	2			1 to 5
24.	Numerical problems.	1			1 to 5
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS {T}/REFERENCE BOOKS{R}
1.	J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994. {T}
2.	D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003. {T}
3.	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995. {R}
4.	A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999. {R}

5.	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012. {R}

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE 306 L	Power System Analysis Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Power System Analysis				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department Of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide comprehensive knowledge on power system analysis problems.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Analyze the performance of short, medium, and long transmission lines							
2.	Use numerical methods to analyze the steady state operation of power systems							
3.	Analyze the behavior of the power system under fault conditions							
4.	Analyze the stability status of power system under transient condition							

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To determine A, B, C, D parameters of short, medium, and long transmission line	1			1&2
2.	To study the Ferranti effect and efficiency of medium, and long transmission line	1			1&2
3.	To find out the string efficiency across the string of insulators	1			1&2
4.	To perform the fault analysis on three-phase alternator	1			1&2
5.	To perform the fault analysis on three-phase transmission line	1			1&2
6.	To perform the fault analysis on three-phase transformer	1			1&2
7.	To study the performance of DC distribution system fed with different configurations	1			1&2
8.	To study the power angle characteristics of alternator with infinite bus bar	1			1&2
9.	To find sequence impedances of three-phase transformer	1			1&2

10.	To find sequence impedances of an alternator	1			1&2
11.	Load flow studies using Gauss-seidel method	1			1&2
12.	Load flow studies using N-R method.	1			1&2
13.	Load flow studies using Fast Decouple method	1			1&2
14.	To study the transient stability analysis	1			1&2
15.	To study the short circuit analysis	1			1&2
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS {T}/REFERENCE BOOKS{R}
1.	J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994. {T}
2.	D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003. {T}
3.	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995. {R}
4.	A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999. {R}
5.	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012. {R}

EEE - 309	Synchronous Machines	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Induction machines, Fundamental of power systems				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	The purpose, of course, is to understand the complete characteristic features of different synchronous machines in their field of applications.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the operational characteristics of alternators.							
b.	Analyze power factor correction capability of synchronous motor.							
c.	analyze starting and running characteristics of single phase induction motor							
d.	understand the suitability of special machines for given							

	application							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I CONSTRUCTIONAL FEATURES OF ALTERNATORS, ARMATURE WINDINGS & LOAD CHARACTERISTICS	**6**			3&4
1.	Construction - Revolving field type, Rotating armature type, Salient pole and non-salient pole field structure, Principle of operation; Relation between speed and frequency of alternator, Methods of cooling.	3			3&4
2.	Voltage regulation, Causes - Effective resistance, Leakage reactance, Armature reaction, Synchronous reactance; Open circuit and short circuit tests, Phasor diagrams.	3			3&4
	UNIT-II METHODS OF PREDICTING REGULATION & SALIENT POLE GENERATOR	**8**			
3.	Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods	4			3&4
4.	Two reaction theory - Direct and quadrature axes synchronous reactance; Slip test, Phasor diagrams, Regulation.	4			3&4
	UNIT- III PARALLEL OPERATION	**9**			
5.	Methods of synchronization, circulating current, Synchronizing power, Effect of change in excitatio	9			3&4

	Effect of change in prime mover torque, Influence governors on load division between parallel units				
	UNIT-IV SYNCHRONOUS MOTOR	**9**			
6.	Principle of operation, Phasor diagram, V and inverted V-curves at constant power output, Hunting and damping, Starting methods, Phasor diagrams of salient pole motor.	5			3&4
7.	Expression for power developed, Conditions of maxima, Stiffness of coupling.	4			3&4
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5.	A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

EEE 309 L	Synchronous Machines Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Synchronous Machines				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

PURPOSE	The purpose, of course, is to understand the complete characteristic features of different synchronous machines in their field of applications.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the operational characteristics of alternators.							
b.	Analyze power factor correction capability of synchronous motor.							
c.	analyze starting and running characteristics of single phase induction motor							
d.	understand the suitability of special machines for given							

	application							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	Regulation of a three –phase alternator by synchronous impedance method	2			1&2
2.	Regulation of a three –phase alternator by synchronous m.m.f. Method	2			1&2
3.	Regulation of three–phase alternator by Potier triangle method	2			1&2
4.	V and Inverted V curves of a three—phase synchronous motor	3			1&2
5.	Determination of Xd and Xq of a salient pole synchronous machine	3			1&2
6.	Determination of efficiency of three phase alternator by loading with three phase induction motor	3			1&2
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2.	M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3.	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5.	A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

ECE 313	Microprocessors and Interfacing	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Science				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The purpose of this course is to impart knowledge of microprocessor architecture and programming, interfacing and coprocessors which gives foundation to advanced microprocessor architecture and microcontrollers.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To study and understand the architecture of 8085 microprocessor.							
2.	To study and understand the architecture of 8086 microprocessor.							
3.	To learn and understand design aspects of I/O and interfacing devices.							
4.	To study about communication and bus interfacing.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: 8086 MICROPROCESSOR	**9**			
1.	8086 architecture- Functional Diagram.	1	C-I		1, 2, 3
2.	Register Organization, Memory segmentation, Memory addresses.	2	C-I		1, 2, 3
3.	physical memory organization, Signal descriptions of 8086-common function signals.	2	C-I		1, 2, 3
4.	Minimum and Maximum mode signals, Read Write cycles.	2	C-I		1, 2, 3
5.	Timing diagrams, Interrupt structure of 8086.	2	C-I		1, 2, 3
	UNIT II– ASSEMBLY LANGUAGE PROGRAMMING OF 8086	**9**			
6.	Instruction formats, addressing modes, instruction set, assembler directives.	2	C-I		1, 2, 3
7.	Simple programs involving logical.	2	C-I		1, 2, 3
8.	Branch and call instructions.	2	C-I		1, 2, 3
9.	Sorting, evaluating arithmetic expressions	2	C-I		1, 2, 3
10.	String manipulations.	1	C-I		1, 2, 3

	UNIT III - PERIPHERAL INTERFACING WITH 8086 MICROPROCESSOR	**9**			
11.	8255 PPI, Keyboard, display controllers, Stepper motor.	2	C-I-O		1, 2, 3
12.	A/D & D/A Converter Interfacing with 8086 microprocessor.	1	C-I-O		1, 2, 3
13.	Static and Dynamic memories, Vector interrupt table.	1	C-I-O		1, 2, 3
14.	Interrupt service routine, Introduction to DOS & BIOS interrupts.	1	C-I-O		1, 2, 3
15.	Programmable Interrupt Controller 8259.	2	C-I-O		1, 2, 3
16.	DMA controller 8257 Interfacing with 8086 microprocessor.	2	C-I-O		1, 2, 3
	UNIT IV: COMMUNICATION INTERFACE	**9**			
17.	Serial communication standards.	2	C-I-O		1, 2, 3
18.	serial data transfer schemes.	2	C-I-O		1, 2, 3
19.	8251 USART architecture and Interfacing.	2	C-I-O		1, 2, 3
20.	RS232.	1	C-I-O		1, 2, 3
21.	prototyping and trouble shooting.	2	C-I-O		1, 2, 3
	UNIT V: INTRODUCTION TO MICROCONTROLLERS	**9**			
22.	Overview of 8051 microcontroller.	2	C-I-O		1, 2, 3
23.	Architecture.	2	C-I-O		1, 2, 3
24.	I/O ports and Memory organization.	2	C-I-O		1, 2, 3
25.	Addressing modes and instruction set of 8051, Simple programs.	3	C-I-O		1, 2, 3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Ramesh S Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, 6th edition, Penram.
2.	D V Hall, “Microprocessors and Interfacing”, MGH, 2nd edition.
3.	The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Edition.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA 1	CLA 2	**Total**
	Weightage	**10%**	**10%**	**5%**	**5%**	**30%**
End semester examination Weightage : 35%						**35%**

ECE 313 L	Microprocessors and Interfacing Lab			L	T	P	C
				0	0	2	1
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	MJ	Major	Engineering				
Course designed by	Department of ECE						
Approval	-- Board of Studies -- , 2018						

PURPOSE	The purpose of this course is to impart knowledge of microprocessor architecture and programming, interfacing and coprocessors which gives foundation to advanced microprocessor architecture and microcontrollers

LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
1.	To study and understand the architecture of 8085 microprocessor.							
2.	To study and understand the architecture of 8086 microprocessor.							
3.	To learn and understand design aspects of I/O and interfacing devices.							
4.	To study about communication and bus interfacing.							

Session	List of Experiments using 8086	Contact hours	C-D-I-O	IOs	Reference
1	(a)Addition of two 8-bit numbers (b)Subtraction of two 8-bit numbers (c)Multiplication of two 8-bitnumbes (d) Division of two 8-bit numbers	1	C-D-I-O		1, 2, 3
2	.(a)Addition of two 16-bit numbers (b)Subtraction of two 16-bit numbers (c)Multiplication of two 16-bit numbers (d)Division of two 16-bit numbers	2	C-D-I-O		1, 2, 3
3	Logical operations using 8086 (a)and (b)or (c)x-or	1	C-D-I-O		1, 2, 3
4	(a) Two digit BCD addition. (b) Two digit BCD subtraction.	1	C-D-I-O		1, 2, 3

5	(a)Sorting of data in ascending order (b)Sorting of data in descending order	1	C-D-I-O		1, 2, 3
6	(a)Program to test whether the 5-bit is '0' or '1' (b)Counting number of '1's in a given data.	1	C-D-I-O		1, 2, 3
7	ASCII arithmetic operations.	1	C-D-I-O		1, 2, 3
8	(a)ALP for conversion of packed BCD to unpacked BCD (b)ALP for conversion of packed BCD to ASCII (C)ALP for conversion of data from BCD to HEX.	2	C-D-I-O		1, 2, 3
9	(a)ALP to move a block of 10 bytes (b)ALP to test the parity of the given data	1	C-D-I-O		1, 2, 3
10	8086 INTERFACING PROGRAAMS: 10.(a) ALP to interface 8086 with 8255 for control of stepper motor. (b)ALP to interface 8086 with 8279 for 7-segment display. (c)ALP to interface 8086 with 8255 to implement traffic light model (d) ALP to interface 8086 with elevator. (e) ALP to interface 8086 with DDAC.	3	C-D-I-O		1, 2, 3
	Total contact hours	**15**			

LEARNING RESOURCES
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 6th edition, Penram.
2. D V Hall, "Microprocessors and Interfacing", MGH, 2nd edition.
3. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Edition.

EEE 314	Nuclear Power Generation	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	OE				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	The nuclear power generation course provides a graduate-level understanding of the nuclear engineering, nuclear reactors, materials, waste disposal and various safety rules.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a)	understand basic concepts like atomic mass, atomic number, radioactive decay							
b)	different types and components of nuclear reactor							
c)	understand nuclear materials like fuel cladding, moderator, control rod, shielding material and their application							
d)	Understand about nuclear waste disposal and radiation protection.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Nuclear Engineering	**9**			
1.	Why Nuclear power, atomic nuclei, atomic mass, atomic number, isotopes	2			1-3
2.	Radioactivity and radioactive change, rate of radioactive decay, mass energy equivalence	2			1-3
3.	Binding Energy, Release of Energy by Nuclear Reaction	1			1-3
4.	Types of Nuclear Reactions	2			1-3
5.	Nuclear Cross – section, Nuclear Fission, Fission Chain Reaction,	2			1-3
6.	Fertile Materials and Breeding	2			1-3
	UNIT II: Nuclear Reactor Power Generation	**9**			
7.	Nuclear Power Systems	2			1-3
8.	Classification of Nuclear Reactors	2			1-3
9.	General Components of nuclear reactors	2			1-3
10.	Power of a nuclear reactor	2			1-3
11.	Comparison of nuclear plants and thermal plants	2			1-3
12.	India's 3 stage Nuclear Power programme	1			1-3
	UNIT-III: Types of nuclear reactors	**9**			
13.	Different types of reactors	1			1-3
14.	Pressurized Water Reactor (PWE)	2			1-3

15.	Boiling Water Reactor (BWR)	2			1-3
16.	CANDU (Canadian Deuterium Uranium) Reactor	2			1-3
17.	Gas cooled reactor	2			1-3
	UNIT IV: Nuclear Materials	**9**			
18.	Introduction	1			1-3
19.	Fuels,	1			1-3
20.	Cladding and Structural Materials Coolants	2			1-3
21.	Moderating and reflecting materials	2			1-3
22.	Control Rod and Shielding Materials	2			1-3
	UNIT-V: Nuclear waste, disposal, and Safety	**9**			
23.	Nuclear Radiation-Unit, Types of Nuclear Waste	2			1-3
24.	Effects of nuclear radiation	1			1-3
25.	Radioactive waste disposal system	2			1-3
26.	Personal Monitoring	1			1-3
27.	Radiation Protection,	2			1-3
28.	Radiation Dose	2			1-3
	Total contact hours	**45**			

	LEARNING RESOURCES	
		TEXTBOOKS[a]/REFERENCE BOOKS[b]
	1[a]	P.K. Nag "Power Plant Engineering ", Tata McGraw Hill
	2[a]	R.K. Rajput "Power Plant Engineering ", Khanna Publishers
	3[b]	John R. Lamarsh & Anthony J. Baratta "Introduction to Nuclear Engineering", Pearson

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

ENV 111	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	2
Co-requisite	NIL				
Prerequisite	NIL				
Data Book / Codes /Standards	NIL				
Course Category	Basic Sciences				
Course Designed by	Department of Environmental Science				
Approval					

PURPOSE	Humanity's impact on our planet has never been greater. This course aims to provide a comprehensive introduction to wide ranging environmental issues and their drivers. This course will help students to understand numerous approaches to reduce a variety of contemporary environmental problems for a sustainable future.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of this course, students will be able to								
a.	Understand the importance of environmental studies and explore sustainable solutions to various environmental issues	A	F	J				
b.	Understand the functioning of ecosystems, matter cycling, and diversity of species around us	A						
c.	Explore various natural resources and impact of their overexploitation on our environment	A	J					
d.	Understand the extent of environmental pollution and diverse regulations, policies and efforts to reduce the environmental burden	A	F	J				

Session	Description of the Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT – 1: ENVIRONMENTAL CRISIS AND SUSTAINABLE DEVELOPMENT	**3**			
1.	Need for environmental science studies Fundamentals of ENV – Atmosphere, lithosphere, hydrosphere, biosphere. Global environmental crisis and its causes, Man-Environment relationship & Interaction.	2	C	1	1,2
2.	Ecological footprint, Sustainable development.	1	C	1	1
	UNIT – 2: ECOSYSTEMS	**6**			
3.	Ecosystem - Structure and functions of an ecosystem.	1	C	**2**	1,2
4.	Energy flow in an ecosystem, biomass flow in an ecosystem, food chain and web Ecological Succession.	1	C	2	1,2
5.	Ecological pyramid, Water cycle, Carbon cycle, Sulphur cycle, Nitrogen cycle.	1	C	2	1,2
6.	Forest ecosystems: tropical rain forest, coniferous forests, tundra forests, temperate forests, Grasslands and desert ecosystems.	2	C	2	1,2,3
7.	Aquatic ecosystems: Freshwater zones, streams, rivers, state of rivers in India, wetlands, Zones in ocean, ocean activities, coastal zones, Estuaries, Mangroves.	1	C	2	1,2,3
	UNIT – 3: RENEWABLE AND NON-RENEWABLE RESOURCES	**7**			

8.	Energy resources: Global energy crisis, energy sources, energy needs, global energy consumption, Renewable and Non-renewable energy sources: Hydropower, Solar, tidal, wind, energy, Bioenergy, coal, natural gas.	2	C,D	3	
9.	Energy resources: fossil fuel vs renewable fuels, peak oil.	1	C	3	1
10.	conventional and unconventional oil, oil price determination.	1	C	3	1
11.	Environmental implications of Energy use: India and world, Energy use pattern – national and global.	1	C,D	3	1
12.	Water availability, Water for irrigation, water situation in India.	2	C,D	3	1,4
	UNIT – 4: BIODIVERSITY	**6**			
13.	Significance of biodiversity, Current state of biodiversity: National and global, Causes of biodiversity loss.	1	C,D	2	1,2,3
14.	Biological hotspots, aquatic biodiversity.	1	C,D	2	1,2,3
15.	Endangered species and endemic species of India.	1	C,D	2	1,2,3
16.	Biodiversity conservation: Seed banks, botanical gardens, marine biodiversity protection, national and international efforts.	2	C,D	2	1,2,3
	UNIT – 5: Environmental Pollution and Control	**8**			
17.	Types of Environmental Pollution Air pollution: Sources, effects, and control Air standards Air pollution in India and the world <u>Sources of air pollution</u> Outdoor & Indoor air pollution Point source, mobile, area source <u>Effects of air pollution:</u> Smog, urban heat island, ozone layer depletion, acid rain <u>Controlling air pollution</u>: Emission regulation, e-cars	1	C,D	4	1,3
18.	Water pollution: Sources & effects Water Quality standards Water pollutants, eutrophication, thermal pollution, bio-magnification Wastewater treatment, Methods of water purification.	1	C,D	4	1,3
19.	Soil pollution: Sources, causes and effects Control of soil pollution: Air purging, phytoremediation, and bio-remediation.	1	C,D	4	1,3
20.	Solid waste management, Types and sources of solid wastes, Hazardous waste, and electronic wastes, Recycling, and management of solid wastes (4Rs), Sanitary landfills and leachate management.	1	C,D	4	1,3
21.	Noise pollution: Sources, effects, and control Air quality standards with respect to noise.	1	C,D	4	
22.	Introduction to Climate change: Impact of climate change, IPCC assessment, Carbon footprint, carbon sequestration, carbon trade, carbon credits, Kyoto protocol, Montreal protocol, Paris agreement.	2	C	4	1

23.	COVID-19: Environmental aspects.	1	C,D	4	5

LEARNING RESOURCES	
Textbooks / Reference Books / Other Reading Material	
1.	R. Rajagopalan (2016). Environmental Studies (3rd edition), Oxford University Press.
2.	Deeksha Dave, S.S. Katewa (2012). Textbook of Environmental Studies (2nd edition), Cengage.
3.	W. Cunningham, M. Cunningham (2016). Principles of Environmental Science (8th Edition), McGraw-Hill.
4.	KL Rao (1979). India's water wealth. Orient Black Swan.
5.	Saadat, S., Rawtani, D., & Hussain, C. M. (2020). Environmental perspective of COVID-19. Science of The Total Environment, 138870.

COURSE NATURE		**Theory**				
Assessment Method (Weightage 100%)						
In-Semester	**Assessment**	Mid-Term I	Mid-Term II	CLA-I	CLA-II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End-Semester	**Assessment**	Theory Exam				**50%**
	Weightage	**50%**				

ENV 111 L	Environmental Science Lab	L	T	P	C
		0	0	2	1
Co-requisite	NIL				
Prerequisite	NIL				
Data Book / Codes /Standards	NIL				
Course Category	Basic Sciences				
Course Designed by	Department of Environmental Science				
Approval					

PURPOSE	This course aims to provide a hands-on experience on various approaches used to understand the extent of pollution in water, air, and soil.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of this course, students will be able to								
a.	Acquire basic knowledge on the measurement of various indices used for water and air quality.	A	B					
b.	Get hands-on experience on basic techniques used for solid waste management and understand how the operational principles of fuel cells.	A	B					

Session	Description of the Topic/Experiment	Contact hours	C-D-I-O	IOs	Reference
	Unit I -Water Quality				
1.	Turbidity and pH of water.	**1**	C,D	1	1
2.	Total suspended solids and total dissolved solids.	1	C,D	1	1
3.	Measurement of Alkalinity & Acidity.	2	C,D	1	1,2,
4.	Dissolved oxygen measurement Using Winkler Method & Biochemical Oxygen Demand.	2	C,D	1	1,2
5.	Hardness of Water.	2	C,D	1	1
6.	Iron concentration in water.	**2**	C,D	1	1
7.	Determination of Chemical Oxygen Demand.	2	C,D	1	1
	Unit II - Air Quality				
8.	Measurement of noise at different sources using Sound Level Meter.	2	C,D	1	3
9.	Monitoring and analysis of Particulate Matter PM_{10} in ambient air.	**2**	C,D	1	3
10.	Monitoring and analysis of Particulate Matter $PM_{2.5}$ in ambient air.	2	C,D	1	3
11.	Sampling and analysis of Nitrogen dioxide in ambient air.	2	C,D	1	3
	Unit III - Solid Waste Management				
12.	Physical characteristics of Solid wastes – Biodegradable and non-degradable wastes Determination of Moisture Content (MC), Total Solids (TS), Total Volatile Solids (TVS) and Ash Content(AC) in solid waste.	2	C,D	2	4
	Unit IV - Energy Resources				
13.	Salt water fuel cell.	2	C,D	2	5

LEARNING RESOURCES	
Textbooks / Reference Books / Other Reading Material	
1.	APHA and AWWA (2017): Standard Methods for the Examination of Water and Wastewater.

	American Public Health Association (APHA), 23rd Ed, Washington, D.C., USA.
2.	Grasshoff, K., Kremling, K., & Ehrhardt, M. (Eds.). (2009). Methods of seawater analysis. John Wiley & Sons.
3.	IS 5182 (Part 23): 2006. https://law.resource.org/pub/in/bis/S02/is.5182.23.2006.pdf
4.	IS:10158-1982 Indian Standard Methods of Analysis of Solid Wastes https://law.resource.org/pub/in/bis/S02/is.10158.1982.html.
5.	Park, S., SenthilKumar, B., Kim, K., Hwang, S. M., & Kim, Y. (2016). Saltwater as the energy source for low-cost, safe rechargeable batteries. *Journal of Materials Chemistry A*, *4*(19), 7207-7213.

COURSE NATURE		**Practical**		
Assessment Method (Weightage 100%)				
In-Semester	**Assessment**	Lab Reports/Records	Project work	**Total**
	Weightage	**25%**	**25%**	**50%**
End-Semester	**Assessment**	Practical Exam		
	Weightage	**50%**		**50%**

ISES 312	Industry Specific Employability Skills-VI	L	T	P	C
		1	1	0	0
Co-requisite:	Nil				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Skill building				
Course designed by	Department of CDC				
Approval					

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic.							
b.	Build vocabulary through methodical approaches and nurture passion for learning new words.							
c.	Helps students create a communication strategy.							
d.	Enable students to draft and design a resume and cover letter. Enable the students to handle the interview process effectively.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**6**			
1.	Antonyms, synonyms, odd words.	2	C and I		1
2.	Idioms and phrasal verbs, same word with different part of speech.	2	C and I		1
3.	Word analogy. Sentence completion.	2			
	UNIT-II	**6**			
4.	Text completion, Sentence equivalence.	2	C and I		1
5.	Introduction to Different Parts of an Argument in Reasoning, Assumption of an Argument.	2	C and I		1,2
6.	Strengthening of an Argument, Weakening of an argument.	2			
	UNIT- III	**6**			
7.	Para jumbles, Sentence Completion & Text Completion.	3	C and I		1
8.	Reading Comprehension, Identification of errors, Sentence correction.	3	C and I		2

	UNIT-IV	6			
9.	Resume writing.	3	C and I		5.6
10.	Cover letter.	3	C and I		5,6
	UNIT-V	6			
11.	GD.	3	C and I		5
12.	PI.	3	C and I		5
	Total contact hours	**30**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Verbal Ability and Reading comprehension-Sharma and Upadhyay.
2.	Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
3.	GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition.
4.	The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.
5	Soft Skills Training: A Workbook to Develop Skills for Employment Book by Frederick H. Wentz.
6	The Resume Writing Guide: A Step-by-Step Workbook for Writing ...Book by Lisa McGrimmon.

SEMESTER VII

EEE 403	Switch Gear and Protection	L	T	P	C
		3	0	0	3

Co-requisite:	NIL
Prerequisite:	1. EEE 301 Electrical Machines 2. EEE 304 Power Systems
Data Book / Codes/Standards	NIL
Course Category	Core
Course designed by	Department of Electrical and Electronics Engineering
Approval	

PURPOSE	To study the working principle and operation conditions of various protective equipment's including their limitations**.**

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	To understand the operation and basic principles of various types of circuit breakers.							
b.	To understand the operation and application of different types of electromagnetic protective relays.							
c.	To study the generator and transformer protection schemes.							
d.	To study the feeder and bus bar protection schemes.							
e.	To understand the protection schemes of different types of over voltages in a power system.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Circuit Breakers	**9**			
1.	Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV	3			1&2
2.	Current chopping and Resistance switching– Introduction to oil circuit breakers.	2			1&2
3.	Description and operation of Air Blast– Vacuum and SF6 circuit breakers.	2			1&2
4.	CB ratings and specifications– Concept of Auto reclosing.	2			1&2
	UNIT-II Electromagnetic Protection	**9**			
5.	Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays.	2			1&2
6.	Torque equation - Relays classification–Instantaneous–DMT and IDMT types.	2			1&2

7.	Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays.	2			1&2
8.	Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.	3			1&2
	UNIT- III Generator and Transformer Protection	**9**			
9.	Protection of generators against stator faults– Rotor fault abnormal conditions.	3			1&2
10.	Restricted earth fault and inter turn fault protection– Numerical examples.	2			1&2
11.	Protection of transformers: Percentage differential protection– Design of CT's ratio.	2			1&2
12.	Buchholz relay protection–Numerical examples.	2			1&2
	UNIT- IV Feeder and Bus bar Protection	**9**			
13.	Protection of lines: Over current Protection schemes – PSM, TMS - Numerical examples.	3			1&2
14.	Carrier current and three zone distance relay using impedance relays.	3			1&2
15.	Protection of bus bars by using Differential protection.	3			1&2
	UNIT- V Protection against over voltage and grounding	**9**			
16.	Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters.	3			1&2
17.	Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance.	3			1&2
18.	Methods of neutral grounding: Solid–resistance– Reactance–Arcing grounds and grounding Practices.	3			1&2
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a].	Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications.
2[a].	Power system protection- Static Relays with microprocessor applications.by T.S.MadhavaRao,TMH.

3[b].	Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
4[b].	Protection and SwitchGear by BhaveshBhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press, 2013.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE 403 L	**Switch Gear and Protection Lab**	**L**	**T**	**P**	**C**
		0	0	2	1

Co-requisite:	Switch Gear and Protection (EEE 403)
Prerequisite:	NIL
Data Book / Codes/Standards	NIL
Course Category	Core
Course designed by	Department of Electrical and Electronics Engineering
Approval	

PURPOSE	To study the working principle and operation conditions of various protective equipment's including their limitations**.**							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	To understand the operation and basic principles of various types of circuit breakers.							
b.	To understand the operation and application of different types of electromagnetic protective relays.							
c.	To study the generator and transformer protection schemes.							
d.	To study the feeder and bus bar protection schemes.							
e.	To understand the protection schemes of different types of over voltages in a power system.							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	Study the characteristics of Over current relay	2			3,4
2.	Determination of Positive, Negative and Zero sequence	2			3,4
3.	Negative sequence over current relay	2			3,4
4.	Study of impedance relay distance protection	2			3,4
5.	Electro mechanical type IDMT earth fault relay test kit	2			3,4
6.	Study the characteristics of Over voltage relay	2			3,4
7.	Study the characteristics of Under voltage relay	1			3,4
8.	Single Phase Differential current relay	2			3,4
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a].	Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications.
2[a].	Power system protection- Static Relays with microprocessor applications.by T.S.MadhavaRao,TMH.
3[b].	Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
4[b].	Protection and SwitchGear by BhaveshBhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press, 2013.

EEE 404	High Voltage Engineering	L	T	P	C
		3	0	0	3
Co-requisite:	Switchgear and Protection (EEE 403)				
Prerequisite:	Fundamentals of Power Systems (EEE 304) Field Theory -BS Elective (PHY 112) Numerical Methods				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide the comprehensive idea of electrical circuits, network theorems, two-port networks, concept and application of graph theory and filters to circuits

LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							

a.	Understand electrical fields and methods of field computation.							
b.	Understand the basic concepts and behavior of different dielectric materials							
c..	Learn the generation of high (dc, ac, and impulse) voltage and currents.							
d.	Learn the different diagnostics techniques for high voltage measurements.							
e.	Learning the testing techniques of insulators, cables, transformers, etc.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Fundamentals of high voltage	**9**			
1.	Introduction to electric field stress.	2	C		1,2
2.	Vacuum, gas, liquid and solid as insulators.	2	C		1,2
3.	Numerical method for electrical field computations.	3	C		1,2
4.	Control and distribution of surge voltages.	1	C		1,2

5.	Illustrative examples.	1	C		1,2
	UNIT II: Breakdown mechanism in dielectric materials	**9**			
6.	Breakdown in gases, Townsend's breakdown mechanism, Streamer mechanism, Paschen's law	3	C		1-3
7.	Breakdown in no-uniform field, partial discharge	1	C		1-3
8.	Breakdown in liquids, Intrinsic Break down, Cavitation Theory, Suspended particle Theory.	2	C		1-3
9.	Breakdown in solids Intrinsic breakdown, Electromechanical break down, Thermal breakdown, Streamer Breakdown.	2	C		1-3
10.	Illustrative examples.	1	C		1-3
	UNIT-III: Generation of dc, ac and impulse voltage	**9**			
11.	Generation of dc high voltage, voltage doubler circuit.	2	C		1-3
12.	Generation of ac high voltage, cascade transformer, resonant transformer.	3	C		1-3
13.	Definition of impulse voltage.	1	C		1-3

14.	Generation of impulse voltage.	2	C		1-3
15.	Illustrative examples.	1	C		1-3
	UNIT IV: Measurement techniques in high voltage	**9**			
16.	Measurement of dc voltage using resistance and capacitance potential dividers.	2	C		1-3
17.	Measurement of high ac voltage.	2	C		1-3
18.	Measurement of currents, using resistive shunts, current transformers and Rogowski coil.	3	C		1-3
19.	Illustrative examples.	2	C		1-3
	UNIT-V: Testing of electrical equipment	**9**			
20.	Introduction to testing of insulators and bushings.	2	C		1-3
21.	Power frequency test and impulse test on insulators.	2	C		1-3
22.	Power frequency test and impulse test on bushings.	1	C		1-3
23.	Testing of transformers, impulse testing.	2	C		1-3

24.	Testing of cables.	2	C		1-3
	Total contact hours	**45**			

	Course nature				**Theory**		
	Assessment Method – Theory Component (Weightage 100%)						
	In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
		Weightage	**15%**	**15%**	**10%**	**10%**	**50%**

EEE 404 L	High Voltage Engineering Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Switchgear and Protection (EEE 403)				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To provide the comprehensive idea of electrical circuits, network theorems, two-port networks, concept and application of graph theory and filters to circuits

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand electrical fields and methods of field computation.							

b.	Understand the basic concepts and behavior of different dielectric materials							
c..	Learn the generation of high (dc, ac, and impulse) voltage and currents.							
d.	Learn the different diagnostics techniques for high voltage measurements.							
e.	Learning the testing techniques of insulators, cables, transformers, etc.							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	AC, DC and impulse breakdown test of insulation	2			
2.	Capacitance and tanδ measurement of insulator	2			
3.	Mapping of electric field lines between two charges using MATLAB	1			
4.	Simulation of impulse voltage generation circuits using PSPICE/PSCAD	1			
5.	Plotting the electrical field distribution in an insulating material using comsol (with and without void)	2			
6.	Measurement of insulation resistance of cable	2			
7.	Plotting φ-q-n pattern for corona discharge using partial discharge detecto r	1			
8.	Travelling wave characteristics with different line terminations using PSCAD	1			
9.	Oil breakdown test using oil test kit	1			
10.	Preparation of epoxy nanocomposite	1			
11.	Dielectric characteristics of solid insulating	1			

	material using impedance analyzer				
	Total contact hours	**15**			

Open Electives

ECE 411	Embedded Systems	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	Digital electronics, Programming with C				
Data Book / Codes/Standards	NIL				
Course Category	P CORE ELECTIVE	Embedded Systems and RTOS			
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The course on embedded systems and RTOS is designed to cover the basic and essential aspects of embedded systems design. The course introduces different types of controllers, with more emphasis on the ARM7 processor. The critical design metrics, types of customized processors, and different protocols are also introduced. The last unit covers a brief about MicroC/OS-II, which is a real-time operating system (RTOS).

LEARNING OBJECTIVES	**STUDENT OUTCOMES**
At the end of the course, student will be able to	
design an application specific processor	
design an efficient embedded system with any given processor	
writeRTOS program modules for efficient use of resources	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Embedded Systems	**8**			
26.	Introduction to embedded systems, examples of embedded systems,	1	C		1,2
27.	Components of embedded systems hardware	1	C		1,2
28.	Design process in embedded system	1	C		1,2
29.	Design metrics, design metrics optimization	1	C		1,2
30.	Time to market, The NRE and unit cost design metrics, The performance design metrics	1	C		1,2
31.	Von Neumann and Harvard Architecture, CISC and RISC architectures	1	C		1,2
32.	Introduction to different controllers: Atmel 89C52, ATMEGA 32, Microchip PIC16F877, ARM 7.	2	C		1,2
	UNIT II : Custom Processor Designs	**12**			
33.	Processor technology – General-purpose processor, single-purpose processor, and application specific processors	2	C		1
34.	IC Technology – PLD, semi-custom, full custom.	1	C		1
35.	Design Technology – RT Synthesis. RT-level combinational and sequential components.	1	C		1
36.	Finite state machine with data (FSMD)	1	C		1

37.	Finite state machines (FSM)	1	C		1
38.	controller and datapath design	1	C		1
39.	Optimization of design	2	C		1
40.	Operation of general-purpose processors – Instruction execution, pipelining, superscalar and VLIW architectures.	1	C		1
41.	Design of Soda Vending machine	1	C		1
42.	Design of Elevator controller	1	C		1
	UNIT III : ARM Processor – Architecture and Interfacing	**13**			
43.	Introduction to ARM core, ARM extension family	1	C		3,4
44.	LPC 2148 architecture, ARM core dataflow model	1	C		3,4
45.	ARM Core extension, overview of instruction set	3	C		3,4
46.	register bank of ARM processor, ARM instruction pipeline	1	C		3,4
47.	memory management	1	C		3,4
48.	Bus architecture (AMBA Bus)	1	C		3,4
49.	interrupt structure, operating modes, Exception Handling	2	C		3,4
50.	ARM-based embedded devices, ARM peripherals	1	C		3,4
51.	other ARM7 features: timer, ADC, DAC, RTC, WDT, PWM etc.	2	C		2
	UNIT IV : Communication Protocols	**6**			
52.	Concept of protocols. Study of serial and parallel communication protocols – UART, SPI,	2	C		1,5
53.	SCI , I2C, CAN, USB, PCI, Ethernet	2	C		1,2,5
54.	Study of wireless protocols - IrDA, Bluetooth, IEEE802.11,	1	C		1
55.	Zigbee, RF modules, GSM modem for AT command study.	1	C		1
	UNITV : Basics of Real-Time Operating System	**9**			
56.	Need of RTOS in Embedded system software, RTOS services in contrast with computer OS. Features of µCOS II.	2	C		5

57.	Foreground/Background systems, Kernel architecture,	1	C		5
58.	Task, Task scheduler, context switching.	1	C		5
59.	Scheduling algorithms – First come first serve, Round Robin, Round Robin with Priority, Shortest job first.	1	C		5
60.	Multitasking, Interrupt service routine (ISR),	1	C		5
61.	Semaphores, Mutexes, Events	1	C		5,6
62.	Inter process communication (IPC) - mailbox, message queues,	1	C		5
63.	pipes, timers, memory management.	1	C		2,5
	Total contact hours	45			

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Interfacing of the ARM Cortex M3 with LED using timers and switches	1	I-O		3,4
2.	Interfacing of a buzzer and relays with ARM Cortex M3.	1	I-O		3,4
3.	Display key number pressed on a 4x4 keypad matrix onto a 7-segment display.	1	I-O		3,4
4.	Modulation of stepper motor speed with PWM.	1	I-O		3,4
5.	Program RTC of ARM Cortex M3 and display the time on LCD display using I2C protocol.	1	I-O		3,4
6.	Implementation of ADC and DAC with ARM Cortex M3	1	I-O		3,4
7.	UART RS232 serial communication	1	I-O		3,4
8.	Study of Zigbee and CAN protocols	1	I-O		3,4
9.	Study of interrupts with ARM Cortex M3.	1	I-O		3,4
10.	Create a task to blink LEDs using µC/OS-II on ARM Cortex M3.	1	I-O		3,4,5
11.	Study of scheduling algorithms using µC/OS-II on ARM Cortex M3.	1	I-O		3,4,5
12.	Study of semaphore and mutex using µC/OS-II on ARM Cortex M3.	2	I-O		3,4,5
13.	Display different messages on LED, LCD, and 7-segment displays simultaneously.	2	I-O		3,4,5
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1	**Vahid and Givargis**,"***Embedded system design : A unified hardware/software introduction***", John Wiley & Sons, Inc. 2002
2	**Raj Kamal**, "**Embedded Systems : Architecture, Programming, and Design**", The McGraw-Hill Companies, Edition 2, 2008.
3	**A.N.Slosse*tal*.,"*ARM System Developer's Guide*"**, Morgan Kaufmann Publishers, 2004
4	**Steve Furber, "*ARM System-on-chip architecture*"**, Addison-Wesley Publications, 2nd Ed., 2000.
5	**Jean J. Labrosse**, "**MicroC/OS-II : The Real-Time Kernel**", CMP Books, Edition 2, 2002
6	**S.V. Iyer and P. Gupta**, "**Embedded Realtime Systems Programming**", The McGraw-Hill Companies, 2004.

Course nature		**Theory**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Mid Exam I	Mid Exam II	**Total**
	Weightage			
End semester examination Weightage:				

ECE 322	VLSI	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	MJ				
Course designed by	Department of ECE				
Approval					

PURPOSE	To learn basic CMOS Circuits. To learn CMOS process technology. To learn techniques of chip design using programmable devices. To learn the concepts of designing VLSI Subsystems**.**

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to		D	F	G	I			
1.	Identify the various IC fabrication methods.							
2.	Express the Layout of simple MOS circuit using Lambda based design rules.							
3.	Apply the Lambda based design rules for subsystem design.							
4.	Differentiate various FPGA architectures.							
5.	Design an application using Verilog HDL.							
6.	Concepts of modelling a digital system using Hardware description Language.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: VLSI Design Flow	**9**			
1.	Specification.	1	C		2,4
2.	Design entry.	1	C		2,4
3.	Functional simulation.	1	C		2,4
4.	Planning placement and routing.	1	C		2,4
5.	Timing simulation.	1	C		2,4
6.	Design Implementation strategies (ASIC, Custom IC and FPGA Design flows) Introduction.	2	D-I-O		2,4
7.	Verilog HDL implementation of basic logic gates.	1	D-I-O		2,4
8.	Combinational and Sequential circuits.	1	C-D-I-O		1

	UNIT II– MOS Transistor	**9**			
9.	Introduction, Ideal I-V characteristics.	1	C		1,3
10.	C-V Characteristics, Simple MOS Capacitance Models.	1	C		1,3
11.	Detailed MOS Gate Capacitance Model.	1	C		1,3
12.	Non-ideal I-V Effects, Mobility Degradation and Velocity Saturation.	1	C		1,3
13.	Channel Length Modulation, Threshold Voltage Effects.	1	C		1,3
14.	Junction Leakage, Body effect, Tunneling.	1	C		1,3
15.	DC Transfer Characteristics: Static CMOS Inverter DC Characteristics.	1	C		1
16.	Beta Ratio Effect, Noise Margin.	1	C		1
17.	Pass Transistor DC Characteristics.	1	C		1
	UNIT III - Combinational Circuit Design	**9**			
18.	CMOS Logic, Inverter, NAND Gate.	1	C-D		1
19.	NOR Gate, Combinational Logic, Compound Gates.	1	C-D		1
20.	Pass Transistors and Transmission Gates, Tristates, Multiplexers.	1	C-D		1
21.	Circuit Families: Static CMOS, Ratioed Circuits.	1	C-D		1
22.	le Voltage Switch Logic, Dynamic Circuits, Complementary Pass-Transistor Logic Circuits.	1	C-		1
23.	Datapath Subsystem: Single-Bit Addition, Ripple Carry Adder.	1	C-D-I-O		1
24.	Carry Look ahead Adder, Carry Save Adder.	1	C-D-I-O		1
25.	Unsigned Array Multiplication, 2's Complement Array Multiplication.	1	C-D-I-O		1,3
26.	Wallace Tree Multiplication.	1	C-D-I-O		1,3
	UNIT IV: Sequential MOS Logic Circuitry	**9**			
27.	Behavioral of Bistable element.	1	C-D-I-O		1,3
28.	SR Latch Circuitry.	1	C-D-I-O		1,3
29.	Clocked latch and Flip Flop Circuitry.	1	C-D-I-O		1,3

30.	C-MOS D-Latch and Edge Triggered Flip-Flop.	2	C-D-I-O		1,3
31.	ıcing Static Circuits: Sequencing Methods.	2	C-D-I-O		1,3
32.	Max-Delay Constraints.	1	C-D-I-O		1,3
33.	Min-Delay Constraints Time Borrowing.	1	C-D-I-O		1,3
34.	Clock Skew.	1	C-D-I-O		1,3
	UNIT V: CMOS Processing Technology	**9**			
35.	CMOS Technologies.	1	C		1,2,3,4
36.	Wafer Formation, Photolithography.	1	C		1,3
37.	Well and Channel Formation, Silicon Dioxide (SiO2).	1	C		1,3
38.	Isolation, Gate Oxide.	1	C		1,3
39.	Gate and Source/Drain Formations.	1	C		1,3
40.	Contacts and Metallization.	1	C		1,3
41.	Passivation.	1	C		1,3
42.	Methodology: Lambda Design Rules.	1	C-D-I-O		1,3
43.	Transistor Scaling, Inverter (nMOS and CMOS).	1	C-D-I-O		1,2,3,4
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Jan Rabaey, AnanthaChandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2003.
2.	M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997.
3.	N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addision Wesley 1993.
4.	ɔb Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005 3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.

Course nature		**Theory**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Mid Exam I	Mid Exam II	**Total**

	Weightage			
End semester examination Weightage :				

ECE 322 L	**VLSI Lab**	**L**	**T**	**P**	**C**	
		0	**0**	**2**	**1**	
Co-requisite:	NIL					
Prerequisite:	NIL					
Data Book / Codes/Standards	NIL					
Course Category	MJ Major	Engineering				
Course designed by	Department of ECE					
Approval						

PURPOSE								
LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
1	Understand CMOS circuit design concepts, scaling, short channel effects, fabrication							
2	Complete different steps in ASIC and Custom IC design flow with Cadence tools							

Session	**List of Experiments**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1.	CMOS inverter.	1	D-I		2,4
2.	CMOS NOR/ NAND gates.	1	D-I		2,4
3.	CMOS XOR and MUX gates.	1	D-I		2,4
4.	CMOS Static / Dynamic logic circuit (register cell).	2	D-I		2,4
5.	CMOS Latch.	1	D-I		2,4
6.	Pass transistor.	2	D-I		2,4
7.	Layout of any combinational circuit (complex CMOS logic gate)	2	D-I		2,4
8.	6T SRAM cell Design and Analysis.	2	D-I		2,4
9.	Layout of 6T SRAM cell and Stability Analysis.	2	D-I		2,4
10.	Course project	3	C-D-I-O		1,2,3,4
	Total contact hours	**15**			

Course nature	Practical	
Assessment Method (Weightage		

In-semester	Assessment tool	Midterm I	Midterm II	Assignment	Class Test	Quiz	Total	Final
	Weightage							50 %
End semester examination Weightage:								50 %

ECE 321	Microwave Theory and Applications	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	MJ				
Course designed by	Department of ECE				
Approval	BOS 2018				

PURPOSE	The course aims at introducing Microwave theory, techniques and applications with practical lab experiments to Electronics and Communication engineering students. Students will learn the theory of microwave network analysis, scattering matrix and parameters for various waveguide and planar components. Students will also learn the design techniques of passive and active microwave components. Moreover, students will get an understanding of Antenna fundaments and microwave tubes along with microwave solid state devices.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to		D	F	G	I			
1.	Understand the techniques of microwave network analysis, scattering matrix and parameters, stripline and microstrip transmission line technology and dielectric resonators.							
2.	Design techniques of microwave passive components such as power dividers, couplers, filters and phase shifters.							
3.	Theory and design techniques of microwave active devices and components such as microwave transistors, Schottky diode, PIN diode, Varactor diode, low-noise amplifiers, power amplifiers, microwave oscillators, microwave mixers.							
4.	Understand the Antenna theory fundamentals.							
5.	Comprehend the theory of Gunn diode, and microwave tubes such as Reflex Klystrons.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Microwave Transmission Lines	**9**			
1.	Introduction, Microwave Spectrum and Bands.	1	C, I		1, 2, 3, 4, 5
2.	Applications of Microwaves	1	C, I		1, 2, 3, 4, 5
3.	Rectangular Waveguides – TE/TM mode analysis.	1	C, I		1, 2, 3, 4, 5

4.	Expressions for Fields,	1	C, I		1, 2, 3, 4, 5
5.	Characteristic Equation and Cut-off Frequencies.	1	C, I		1, 2, 3, 4, 5
6.	Filter Characteristics, Dominant and Degenerate Modes.	1	C, I		1, 2, 3, 4, 5
7.	Sketches of TE and TM mode fields in the cross-section.	1	C, I		1, 2, 3, 4, 5
8.	Mode Characteristics – Phase and Group Velocities.	1	C, I		1, 2, 3, 4, 5
9.	Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide. Related Problems.	1	C, I		1, 2, 3, 4, 5
	UNIT II– Circular Waveguides	**9**			
10.	Introduction, Nature of Fields.	1	C, I		1, 2, 3, 4, 5
11.	Characteristic Equation, Dominant and Degenerate Modes.	1	C, I		1, 2, 3, 4, 5
12.	Impossibility of TEM mode.	1	C, I		1, 2, 3, 4, 5
13.	Micro strip Lines– Introduction.	1	C, I		1, 2, 3, 4, 5
14.	Z_0 Relations, Effective Dielectric Constant.	1	C, I		1, 2, 3, 4, 5
15.	Losses, Q factor.	1	C, I		1, 2, 3, 4, 5
16.	Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities.	1	C, I		1, 2, 3, 4, 5
17.	Dominant Modes and Resonant Frequencies.	1	C, I		1, 2, 3, 4, 5
18.	Q factor and Coupling Coefficients. Related Problems.	1	C, I		1, 2, 3, 4, 5
	UNIT III - Waveguide Components And Applications	**9**			
19.	Coupling Mechanisms – Probe, Loop.	1	C, D, I, O		1, 2, 3, 4, 5
20.	Aperture types. Waveguide Discontinuities – Waveguide irises.	1	C, D, I, O		1, 2, 3, 4, 5
21.	Tuning Screws and Posts.	1	C, D, I, O		1, 2, 3, 4, 5
22.	Matched Loads. Waveguide Attenuators – Resistive Card.	1	C, D, I, O		1, 2, 3, 4, 5
23.	Rotary Vane types; Waveguide Phase Shifters – Dielectric.	1	C, D, I, O		1, 2, 3, 4, 5
24.	Rotary Vane types.	1	C, D, I, O		1, 2, 3, 4, 5
25.	Waveguide Multiport Junctions – E plane and H plane Tees.	1	C, D, I, O		1, 2, 3, 4, 5
26.	Magic Tee, Hybrid Ring; Directional Couplers – 2 Hole	1	C, D, I, O		1, 2, 3, 4, 5

27.	Bethe Hole types.	1	C, D, I, O		1, 2, 3, 4, 5
	UNIT IV: Microwave Tubes	**9**			
28.	Limitations and Losses of conventional tubes at microwave frequencies. Microwave tubes – O type and M type classifications.	1	C, D, I, O		1, 2, 3, 4, 5
29.	O-type tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities.	1	C, D, I, O		1, 2, 3, 4, 5
30.	Velocity Modulation Process and Applegate Diagram.	1	C, D, I, O		1, 2, 3, 4, 5
31.	Bunching Process and Small Signal Theory – Expressions for o/p Power and Efficiency.	1	C, D, I, O		1, 2, 3, 4, 5
32.	Reflex Klystrons – Structure.	1	C, D, I, O		1, 2, 3, 4, 5
33.	Applegate Diagram and Principle of working.	1	C, D, I, O		1, 2, 3, 4, 5
34.	Mathematical Theory of Bunching, Power Output.	1	C, D, I, O		1, 2, 3, 4, 5
35.	Efficiency, Electronic Admittance; Oscillating Modes and o/p Characteristics.	1	C, D, I, O		1, 2, 3, 4, 5
36.	Electronic and Mechanical Tuning. Related problems.	1	C, D, I, O		1, 2, 3, 4, 5
	UNIT V: Microwave Solid State Devices	**9**			
37.	Introduction, Classification, Applications.	2	C, D, I, O		1, 2, 3, 4, 5
38.	TEDs – Introduction, Gunn Diode – Principle.	1	C, D, I, O		1, 2, 3, 4, 5
39.	RWH Theory, Characteristics.	1	C, D, I, O		1, 2, 3, 4, 5
40.	Basic Modes of Operation.	1	C, D, I, O		1, 2, 3, 4, 5
41.	Oscillation Modes.	1	C, D, I, O		1, 2, 3, 4, 5
42.	Avalanche Transit Time Devices – Introduction.	1	C, D, I, O		1, 2, 3, 4, 5
43.	IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics.	2	C, D, I, O		1, 2, 3, 4, 5
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Microwave Devices and Circuits — Samuel V. Liao, Pearson, 3rd Edition, 2003.
2.	Microwave Principles — Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.
3.	Foundations for Microwave Engineering — R.E. Collin, IEEE Press, John Wiley, 2ndEdition, 2002.
4.	Microwave Circuits and Passive Devices — M.L. Sisodia and G.S. Raghuvanshi, Wiley Eastern Ltd., New Age International Publishers Ltd., 1995.
5.	Microwave Engineering Passive Circuits — Peter A. Rizzi, PHI, 1999

Course nature		**Theory**		
Assessment Method (Weightage 100%)				
In-semester	**Assessment tool**	Mid Exam I	Mid Exam II	**Total**
	Weightage			
End semester examination Weightage :				

ECE 321L	**LABORATORY:** Microwave Theory and Applications Lab	L	T	P	C
		0	0	2	1
Co-requisite:	Microwave Theory and Applications Lab (ECE 321)				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	(MJ) Major				
Course designed by	Department of Electronics and Communication Engineering				
Approval	BOS 2018				

PURPOSE	The course aims to give the experimental skills related to fundamental concepts and working principal of microwave sources, guided medium, and display units. The students will understand wave propagation in guided media. The purpose of lab experiments is verify theoretical aspects with the help of experiments. This course mainly enables the students to gain sufficient knowledge on wave propagation phenomena through various microwave components and characteristic parameters associated with it .

LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
1	Understand basic Microwave components and its operation in Microwave test bench							
2	The opeartion of different measurement equipments like CRO, VSWR meter							
3	Gain practical experience to understand wave propagation in guided media							
4	Understand the relationships and differences between theory and practice							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1	Study the components used in microwave Test-bench	2	I, O		1, 2, 3
2	Study of V-I Characteristics of Gunn Diode	1	I, O		1, 2, 3
3	To determine the frequency and wavelength in a rectangular waveguide working on TE_{10} mode	1	I, O		1, 2, 3
4	Impedance Measurement	1	I, O		1, 2, 3
5	VSWR measurement	1	I, O		1, 2, 3
6	Study- Characteristics of Reflex Klystron	2	I, O		1, 2, 3
7	Attenuation Measurement	1	I, O		1, 2, 3
8	Simulation study of Smith chart - Single and double stub matching.	2	I, O		1, 2, 3
9	Measurement of S-parameters of E-plane Tee & H-plane Tee.	2	I, O		1, 2, 3
10	Study the Characteristics Of Magic Tee.	2	I, O		1, 2, 3
11	Measuring of dielectric constant of a material using waveguide test bench at X-band.	1	I, O		1, 2, 3
	Total contact hours (Including demo and repeat labs)	**16**			

	LEARNING RESOURCES	
		TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1	Robert E Collin, “Foundations for Microwave Engineering”, Wiley, 2nd Edition, 2007.
2	David M Pozar, “Microwave Engineering”, Wiley, 4th Edition, 2004.
3	S.Y. Liao, "Microwave Devices and Circuits", Pearson, 4th Edition, 2000.

Course nature				Practical				
Assessment Method (Weightage								
In-semester	Assessment tool	Midterm I	Midterm II	Assignment	Class Test	Quiz	Total	Final
	Weightage							50 %
End semester examination Weightage:								50 %

ME 225	3D Printing	L	T	P	C
		0	0	2	1
Co-requisite:					
Prerequisite:					
Data Book / Codes/Standards					
Course Category					
Course designed by	DEPARTMENT OF				
Approval	-- Academic Council Meeting -- , 20				

PURPOSE	

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.								
2.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	**4**			
1.	Concepts of CAD, Algorithms used in design, Design of Assembly (Spur gear, Helical screw, simple design)	2			
2.	Introduction to G Code.	1			
3.	Lab practice of Solid works software.	1			
	UNIT-II	**4**			
4.	What is a Mesh?, Historical Review of 3DP, From CAD to CAM, CAD Overview, Introductory lecture on 3D printer and Rapid Prototyping	2			
5.	Introduction to Rapid prototype, Introduction to different types of 3D Printers.	1			
6.	Introduction to RepRap, Materials used for printing.	1			
	UNIT- III	**4**			
7.	Design for 3DP, Understand the basics of G code generation.	2			
8.	CAM Skills, Mesh Repair.	1			
9.	Get to Know the 3D Printer, Weekly Assignments (3DP).	1			
	UNIT-IV	**3**			

10.	Installation of 3DP, bed levelling, filament loading and unloading.	1			
11.	, pre heating, nozzle cleaning and various techniques while printing the complex shapes.	2			
	Total contact hours	**15**			

LEARNING RESOURCES	
	TEXTBOOKS/
1.	3D Printing and Additive Manufacturing (Principles and Applications), By Chee Kai Chua and Kah Fai Leong.
	REFERENCE BOOKS/OTHER READING MATERIAL
2.	Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution by Liza and Nick.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage:						

Technical Electives

EEE XXX	High Voltage DC Transmission	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	1. Power Electronics 2. Power Systems 3. Control Systems				
Data Book / Codes/Standards	NIL				
Course Category	P Core				
Course designed by	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING				
Approval					

PURPOSE	

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn the basic concepts of HVDC Transmission							
2.	To understand the operation of HVDC conversion technology							
3.	To know the HVDC converters and their control system							
4.	To Understand the significance of reactive power control and AC/DC load flow							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction				
1.	Introduction of HVDC Transmission.	1			
2.	Types of HVDC Links.	1			
3.	Apparatus required for HVDC Systems.				
4.	Comparison of AC and DC transmission.				
5.	Limitation of HVDC transmission.				
6.	Application of DC Transmission System, Planning & Modern trends in DC Transmission.				
	UNIT-II Analysis of HVDC Converter				
7.	Choice of converter configuration.	1			
8.	Analysis of Graetz, characteristics of 6 pulse & 12	1			

	pulse converters.				
9.	Cases of two 3 phase converters in star –star mode and their performance.				
	UNIT- III Converter and HVDC System Control				
10.	Principal of DC Link Control.	1			
11.	Converters Control Characteristics.	1			
12.	Firing angle control.				
13.	Current and extinction angle control.				
14.	Effect of source inductance on the system.				
15.	Starting and stopping of DC link - Power Control.				
	UNIT-IV Reactive Power and Harmonics Control				
16.	Reactive power requirements in steady state.	1			
17.	Sources of reactive power.	1			
18.	Static VAR systems.	1			
19.	Reactive power control during transients.	1			
20.	Harmonics and filters.				
21.	Generation of harmonics, Design of AC filters, DC filters.				
	UNIT – V Power Flow Analysis in AC/DC Systems				
22.	Modelling of DC Links.	1			
23.	DC Network.				
24.	DC Converter.				
25.	Controller Equations.				
26.	Solution of DC load flow.				
27.	Solution of AC-DC Power flow.				
28.	Simultaneous method, Sequential method.				
	Total contact hours	31			

LEARNING RESOURCES

	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited, and Publishers.
2.	J Arrillaga, "High Voltage Direct current Transmission", Peter PeregrinusLtd, UK.
3.	HVDC Transmission by S.Kamakshaiah andV.Kamaraju-Tata McGraw–Hill.
4.	EW Kimbark, "Direct Current Transmission", Wiley-Interscience, New York.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage :						

EEE XXX	**Power Quality**	**L**	**T**	**P**	**C**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P				
Course designed by	DEPARTMENT OF EEE				
Approval	-- Academic Council Meeting -- , 2016				

PURPOSE	

LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
1.	To impart knowledge about the power quality and its assessments.							
2.	To introduce the fundamental concepts of waveform processing techniques, monitoring of power qualities disturbances.							
3.	To enable the students to understand how power quality studies are carried out in a distribution system.							
4.	To enable the students to understand the factors that causes the harmonics and their effect on the power system.							
5.	To enable the student to understand how harmonic students are carried out in a power system.							
6.	To enable the student to understand the design concepts of grounding.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I				
1.	Introduction: Power quality-voltage quality-overview of power quality phenomena-classification of power quality issues	1			
2.	Power quality measures and standards-THD-TIF-DIN- message weights-flicker factor-transient phenomena occurrence of power quality problems-power acceptability curves-IEEE guides	1			
3.	EMC standards and recommended practices				
	UNIT-II				
4.	Power Assessment Under Waveform Distortion: Introduction, single phase definitions, three phase definitions, illustrative examples.	1			
5.	Waveform Processing Techniques: Fundamental frequency characterization, Fourier analysis, Fast Fourier Transform, Window functions	1			
6.	Efficiency of FFT algorithms, alternative transforms, wavelet transform, Hartley transform, Automation of disturbance recognition.				
	UNIT- III				
7.	Power Quality Monitoring: Introduction, transduce , power quality instrumentation	1			
8.	Harmonic monitoring, event recording, flicker	1			

	monitoring, assessment of voltage and current unbalance, examples of application				
9.	Evaluation of power system harmonic distortion: Introduction, direct harmonic analysis, incorporation of harmonic voltage sources, derivation of network harmonic impedances, solution by direct injection.				
10.	Representation of individual power system components, implementation of harmonic analysis, post processing and display of results.				
	UNIT-IV				
11.	Harmonic Mitigation: Passive filtering, Harmonic resonance	1			
12.	Impedance Scan Analysis-Active Power Factor Corrected Single Phase Front End	1			
13.	Introduction to three Phase APFC and Control Techniques.	1			
	UNIT – V				
14.	Grounding: Grounding and wiring–introduction-NEC grounding requirements.	1			
15.	Reasons for grounding-typical grounding and wiring problems solutions to grounding and wiring problems.				
	Total contact hours	31			

LEARNING RESOURCES	
	TEXT BOOKS
1.	Electric Power Quality by G. T. Heydt, Stars in a Circle Publishers.
2.	Understanding Power Quality Problems by Math H. Bollen John Wiley and Sons.
	Reference Books:
1.	Power System Quality Assessment by J. Arrillaga and N. R. Watson John Wiley and Sons.
2.	Power System Harmonic Analysis by J. Arrillaga, B. C. Smith, N. R. Watson & A. R. Wood John Wiley.
3.	Electrical Power System Quality by Surya Santoso, H. Wayne Beaty, Roger C. Dugan, MarkF.McGranaghanMcGraw Hills.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					

End semester examination Weightage :	

EEE XXX	Pulsed Power Systems	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	TE				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	

LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
e)	Get an overview of pulse power systems including energy storage devices, voltage multiplier circuits							
f)	Understand the insulation aspects of pulse power systems							
g)	Understand the different types of high-power switches							
h)	apply pulse power systems for different applications							

S. No	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Pulse Power Engineering	**13**			
1.	Overview of Pulse Power Systems	2			1-3
2.	Energy Storage Devices (capacitive, inductive, kinetic, chemical)	4			1-3
3.	Voltage Multiplier Circuits (Pulsed power generators, Pulse transformers, Blumlein generators)	4			1-3
4.	Transmission lines and pulse forming networks.	2			1-3
5.	Illustrative Examples	1			1-3
	UNIT II: Insulation requirements for Pulsed Power Systems	**11**			
6.	Gaseous insulation behavior under pulsed voltage	2			1-3
7.	Liquid insulation behavior under pulsed voltage	2			1-3
8.	Solid insulation behavior under pulsed voltage	2			1-3
9.	Measurement techniques of pulsed power parameters	4			1-3
10.	Illustrative Examples	1			1-3
	UNIT III: Switches	**10**			
11.	Spark gaps	1			1-3
12.	Low pressure switches	2			1-3
13.	Liquid and Solid-state Switches	2			1-3
14.	Magnetic switches	2			1-3
15.	Electromagnetic field analysis of pulsed power circuits	2			1-3
	UNIT IV: Applications of Pulsed Power Systems	**11**			
16.	Pulsed Power Systems for: High Power Microwaves (HPM)	2			1-3
17.	Pulsed Power Systems for: Ultra-Wide Band (UWB) Systems	2			1-3
18.	Nuclear electromagnetic fields, Railgun	2			1-3
19.	High power lasers	2			1-3
20.	Pulsed power systems for biological and pollution Control applications.	2			1-3
21.	Illustrative Examples	1			
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a]	Pai and Zhang, Introduction to High Power Pulse Technology, World Scientific Publishing, 1995.
2[a]	Martin et al., J. C. Martin on Pulsed Power, Plenum Press, 1996.

3[b]	G.A. Mesyats, Pulsed Power, Kluwer Academics/Plenum 2005.

Course nature		**Theory**				
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE XXX	**FACTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	TE				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE								
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a)	Understand need for FACT controllers							
b)	learn the characteristics, applications of series and shunt FACTS controllers							
c)	carry out and modelling of different FACTS controllers							

S. No	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT I: Introduction	**9**			
1.	Review of basics of power transmission networks-control of power flow in AC transmission line-	2			1-3

2.	Analysis of uncompensated AC Transmission line-	2			1-3
3.	Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer	3			1-3
4.	Compensation by STATCOM and SSSC	2			1-3
	UNIT II: Principles of Conventional Reactive Power Compensators	**9**			
5.	Synchronous condenser,	1			1-3
6.	Saturated reactor,	2			1-3
7.	Thyristor-controlled reactor (TCR), Thyristor controlled transformer (TCT),	2			1-3
8.	Fixed capacitor-Thyristor controlled reactor (FC-TCR), Thyristor switched capacitor (TSC),	2			1-3
9.	Thyristor-switched capacitor-thyristor controlled reactor (TSC-TCR)	2			1-3
	UNIT III: Static Var Compensators	**9**			
10.	Analysis of SVC, Configuration of SVC, SVC Controller,	1			1-3
11.	Modelling of SVC, Voltage regulator Design, Voltage control by the SVC,	2			1-3
12.	Advantages of the slope in the SVC Dynamic Characteristic,	2			1-3
13.	Influence of the SVC on System Voltage	2			1-3
14.	Design of the SVC Voltage Regulator	2			1-3
	UNIT IV: Static Synchronous Compensators (STATCOM) and Thyristor Controlled Series Capacitor (TCSC)	**9**			
15.	STATCOM-Principle of operation	1			1-3
16.	Analysis of a three phase six pulse STATCOM, Multi-pulse converters,	2			1-3
17.	Applications of STATCOM	1			1-3
18.	TCSC -Principle of operation,	1			1-3
19.	Analysis, and control	2			1-3
20.	Modelling and Applications	2			
	UNIT V: Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC)	9			
21.	SSSC -Principle of operation,	1			1-3
22.	Analysis, and control	2			1-3

23.	Modelling and Applications	2			1-3
24.	UPFC) Operation of UPFC, Control & Protection,	2			1-3
25.	Modelling, Applications of UPFC	2			1-3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a]	Padiyar K.R. "FACTS controller in power transmission and distribution", New Age international, Edition 1st 2007
2[a]	N.G. Hingorani , "Understanding FACTS", IEEE Press 2001
3[b]	Bjarne R. Andersen and Stig L. Nilsson "Flexible AC Transmission Systems", Springer International Publishing ,2020

Course nature		**Theory**				
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE XXX	Nonlinear Control Systems	L	T	P	C
		3	0	0	3
Co-requisite:					
Prerequisite:					
Data Book / Codes/Standards					
Course Category	P				
Course designed by	DEPARTMENT OF EEE				
Approval	-- Academic Council Meeting -- , 2021				

PURPOSE	

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.								
2.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction and Second-order Systems	**9**			
1.	Nonlinear models and nonlinear phenomena; examples	1			
2.	Qualitative behavior of limit systems; multiple equilibria	1			
3.	qualitative behavior of near equilibrium points	2			
4.	limit cycles; numerical construction of phase portraits	1			
5.	existence of periodic orbits; bifurcations	1			
6.	Existence and uniqueness; continuous dependence on initial conditions and parameters	2			
7.	differentiability of solutions and sensitivity; comparison principle	1			
	UNIT-II Lyapunov Stability	**9**			
8.	Autonomous systems; invariance principle	1			
9.	linear systems and linearization; comparison functions	1			
10.	nonautonomous systems	2			

11.	linear time-varying systems and linearization	1			
12.	converse theorems	1			
13.	boundedness and ultimate boundedness	1			
14.	input-to-state stability	2			
	UNIT- III Input-output Stability	**9**			
15.	L stability; L stability of state models; L2 gain	2			
16.	the small-gain theorem	1			
17.	Memoryless functions; state models	2			
18.	positive real transfer functions	1			
19.	L2 and Lypaunov stability	2			
20.	passivity theorems	1			
	UNIT-IV Frequency Domain Analysis	**9**			
21.	Absolute stability; circle criterion	1			
22.	Popov criterion; describing function method	2			
23.	Centre manifold theorem; region of attraction	2			
24.	invariance-like theorems	2			
25.	stability of periodic solutions	2			
	UNIT – V Stabilization	**9**			
26.	Control problems	1			
27.	optimality and limiting behavior; minimum entropy controllers	1			
28.	stabilization via linearization	2			
29.	input-output linearization	2			
30.	full-state linearization	2			
31.	sliding mode control	1			
	Total contact hours	45			

LEARNING RESOURCES

	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	H. K. Khalil, "Nonlinear Systems", 3rd edition, Prentice Hall, 2002
2.	M. Vidyasagar, "Nonlinear Systems", 2nd edition, SIAM, 2002.
3.	A. Isidori, "Nonlinear Control System", 3rd edition, Springer, 1995
4.	S. Sastry, "Nonlinear Systems: Analysis, Stability and Control", Springer, 1999
5.	A. Van der Schaft, "L2-gain and Passivity Techniques in Nonlinear Control", Springer 1996

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage :						

Technical Electives

EEE XXX	High Voltage DC Transmission	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	1. Power Electronics 2. Power Systems 3. Control Systems				
Data Book / Codes/Standards	NIL				
Course Category	P	Core			
Course designed by	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING				
Approval					

PURPOSE	

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To learn the basic concepts of HVDC Transmission							
2.	To understand the operation of HVDC conversion technology							
3.	To know the HVDC converters and their control system							
4.	To Understand the significance of reactive power control and AC/DC load flow							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction				
29.	Introduction of HVDC Transmission.	1			
30.	Types of HVDC Links.	1			
31.	Apparatus required for HVDC Systems.				
32.	Comparison of AC and DC transmission.				
33.	Limitation of HVDC transmission.				
34.	Application of DC Transmission System, Planning & Modern trends in DC Transmission.				
	UNIT-II Analysis of HVDC Converter				

35.	Choice of converter configuration.	1			
36.	Analysis of Graetz, characteristics of 6 pulse & 12 pulse converters.	1			
37.	Cases of two 3 phase converters in star –star mode and their performance.				
	UNIT- III Converter and HVDC System Control				
38.	Principal of DC Link Control.	1			
39.	Converters Control Characteristics.	1			
40.	Firing angle control.				
41.	Current and extinction angle control.				
42.	Effect of source inductance on the system.				
43.	Starting and stopping of DC link - Power Control.				
	UNIT-IV Reactive Power and Harmonics Control				
44.	Reactive power requirements in steady state.	1			
45.	Sources of reactive power.	1			
46.	Static VAR systems.	1			
47.	Reactive power control during transients.	1			
48.	Harmonics and filters.				
49.	Generation of harmonics, Design of AC filters, DC filters.				
	UNIT – V Power Flow Analysis in AC/DC Systems				
50.	Modelling of DC Links.	1			
51.	DC Network.				
52.	DC Converter.				
53.	Controller Equations.				
54.	Solution of DC load flow.				
55.	Solution of AC-DC Power flow.				
56.	Simultaneous method, Sequential method.				
	Total contact hours	31			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited, and Publishers.
2.	J Arrillaga, "High Voltage Direct current Transmission", Peter PeregrinusLtd, UK.
3.	HVDC Transmission by S.Kamakshaiah andV.Kamaraju-Tata McGraw–Hill.
4.	EW Kimbark, "Direct Current Transmission", Wiley-Interscience, New York.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage :						

EEE XXX	**Power Quality**	**L**	**T**	**P**	**C**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	P				

Course designed by	DEPARTMENT OF EEE
Approval	-- Academic Council Meeting -- , 2016

PURPOSE	

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	To impart knowledge about the power quality and its assessments.							
2.	To introduce the fundamental concepts of waveform processing techniques, monitoring of power qualities disturbances.							
3.	To enable the students to understand how power quality studies are carried out in a distribution system.							
4.	To enable the students to understand the factors that causes the harmonics and their effect on the power system.							
5.	To enable the student to understand how harmonic students are carried out in a power system.							
6.	To enable the student to understand the design concepts of grounding.							

Session	**Description of Topic**	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
	UNIT-I				
16.	Introduction: Power quality-voltage quality-overview of power quality phenomena-classification of power quality issues	1			
17.	Power quality measures and standards-THD-TIF-DIN- message weights-flicker factor-transient phenomena occurrence of power quality problems-power acceptability curves-IEEE guides	1			
18.	EMC standards and recommended practices				
	UNIT-II				
19.	Power Assessment Under Waveform Distortion: Introduction, single phase definitions, three phase definitions, illustrative examples.	1			
20.	Waveform Processing Techniques: Fundamental frequency characterization, Fourier analysis, Fast Fourier Transform, Window functions	1			
21.	Efficiency of FFT algorithms, alternative transforms, wavelet transform, Hartley transform, Automation of disturbance recognition.				
	UNIT- III				
22.	Power Quality Monitoring: Introduction, transduce	1			

	', power quality instrumentation				
23.	Harmonic monitoring, event recording, flicker monitoring, assessment of voltage and current unbalance, examples of application	1			
24.	Evaluation of power system harmonic distortion: Introduction, direct harmonic analysis, incorporation of harmonic voltage sources, derivation of network harmonic impedances, solution by direct injection.				
25.	Representation of individual power system components, implementation of harmonic analysis, post processing and display of results.				
	UNIT-IV				
26.	Harmonic Mitigation: Passive filtering, Harmonic resonance	1			
27.	Impedance Scan Analysis-Active Power Factor Corrected Single Phase Front End	1			
28.	Introduction to three Phase APFC and Control Techniques.	1			
	UNIT – V				
29.	Grounding: Grounding and wiring–introduction-NEC grounding requirements.	1			
30.	Reasons for grounding-typical grounding and wiring problems solutions to grounding and wiring problems.				
	Total contact hours	31			

LEARNING RESOURCES	
	TEXT BOOKS
1.	Electric Power Quality by G. T. Heydt, Stars in a Circle Publishers.
2.	Understanding Power Quality Problems by Math H. Bollen John Wiley and Sons.
	Reference Books:
1.	Power System Quality Assessment by J. Arrillaga and N. R. Watson John Wiley and Sons.
2.	Power System Harmonic Analysis by J. Arrillaga, B. C. Smith, N. R. Watson & A. R. Wood John Wiley.
3.	Electrical Power System Quality by Surya Santoso, H. Wayne Beaty, Roger C. Dugan, MarkF.McGranaghanMcGraw Hills.

Course nature	**Theory**	
Assessment Method (Weightage 100%)		

In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage :						

EEE XXX	**Pulsed Power Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	TE				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE								
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
i)	Get an overview of pulse power systems including energy storage devices, voltage multiplier circuits							
j)	Understand the insulation aspects of pulse power systems							

k)	Understand the different types of high-power switches							
l)	apply pulse power systems for different applications							

S. No	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Pulse Power Engineering	**13**			
22.	Overview of Pulse Power Systems	2			1-3
23.	Energy Storage Devices (capacitive, inductive, kinetic, chemical)	4			1-3
24.	Voltage Multiplier Circuits (Pulsed power generators, Pulse transformers, Blumlein generators)	4			1-3
25.	Transmission lines and pulse forming networks.	2			1-3
26.	Illustrative Examples	1			1-3
	UNIT II: Insulation requirements for Pulsed Power Systems	**11**			
27.	Gaseous insulation behavior under pulsed voltage	2			1-3
28.	Liquid insulation behavior under pulsed voltage	2			1-3
29.	Solid insulation behavior under pulsed voltage	2			1-3
30.	Measurement techniques of pulsed power parameters	4			1-3
31.	Illustrative Examples	1			1-3
	UNIT III: Switches	**10**			
32.	Spark gaps	1			1-3
33.	Low pressure switches	2			1-3
34.	Liquid and Solid-state Switches	2			1-3
35.	Magnetic switches	2			1-3
36.	Electromagnetic field analysis of pulsed power circuits	2			1-3
	UNIT IV: Applications of Pulsed Power Systems	**11**			
37.	Pulsed Power Systems for: High Power Microwaves (HPM)	2			1-3
38.	Pulsed Power Systems for: Ultra-Wide Band (UWB) Systems	2			1-3
39.	Nuclear electromagnetic fields, Railgun	2			1-3
40.	High power lasers	2			1-3
41.	Pulsed power systems for biological and pollution Control applications.	2			1-3
42.	Illustrative Examples	1			
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a]	Pai and Zhang, Introduction to High Power Pulse Technology, World Scientific Publishing, 1995.
2[a]	Martin et al., J. C. Martin on Pulsed Power, Plenum Press, 1996.
3[b]	G.A. Mesyats, Pulsed Power, Kluwer Academics/Plenum 2005.

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE XXX	**FACTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	TE				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE								
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
d)	Understand need for FACT controllers							
e)	learn the characteristics, applications of series and shunt FACTS controllers							
f)	carry out and modelling of different FACTS controllers							

S. No	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction	**9**			
26.	Review of basics of power transmission networks-control of power flow in AC transmission line-	2			1-3
27.	Analysis of uncompensated AC Transmission line-	2			1-3
28.	Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer	3			1-3
29.	Compensation by STATCOM and SSSC	2			1-3
	UNIT II: Principles of Conventional Reactive Power Compensators	**9**			
30.	Synchronous condenser,	1			1-3
31.	Saturated reactor,	2			1-3
32.	Thyristor-controlled reactor (TCR), Thyristor controlled transformer (TCT),	2			1-3
33.	Fixed capacitor-Thyristor controlled reactor (FC-TCR), Thyristor switched capacitor (TSC),	2			1-3
34.	Thyristor-switched capacitor-thyristor controlled reactor (TSC-TCR)	2			1-3
	UNIT III: Static Var Compensators	**9**			
35.	Analysis of SVC, Configuration of SVC, SVC Controller,	1			1-3
36.	Modelling of SVC, Voltage regulator Design, Voltage control by the SVC,	2			1-3
37.	Advantages of the slope in the SVC Dynamic Characteristic,	2			1-3
38.	Influence of the SVC on System Voltage	2			1-3
39.	Design of the SVC Voltage Regulator	2			1-3
	UNIT IV: Static Synchronous Compensators (STATCOM) and Thyristor Controlled Series Capacitor (TCSC)	**9**			
40.	STATCOM-Principle of operation	1			1-3
41.	Analysis of a three phase six pulse STATCOM, Multi-pulse converters,	2			1-3
42.	Applications of STATCOM	1			1-3
43.	TCSC -Principle of operation,	1			1-3
44.	Analysis, and control	2			1-3
45.	Modelling and Applications	2			

	UNIT V: Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC)	9			
46.	SSSC -Principle of operation,	1			1-3
47.	Analysis, and control	2			1-3
48.	Modelling and Applications	2			1-3
49.	UPFC) Operation of UPFC, Control & Protection,	2			1-3
50.	Modelling, Applications of UPFC	2			1-3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS[a]/REFERENCE BOOKS[b]
1[a]	Padiyar K.R. "FACTS controller in power transmission and distribution", New Age international, Edition 1st 2007
2[a]	N.G. Hingorani , "Understanding FACTS", IEEE Press 2001
3[b]	Bjarne R. Andersen and Stig L. Nilsson "Flexible AC Transmission Systems", Springer International Publishing ,2020

Course nature				**Theory**		
Assessment Method – Theory Component (Weightage 100%)						
In-semester	**Assessment tool**	Mid Term I	Mid Term II	CLA-1	CLA-2	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage: 50%						**50%**

EEE XXX	Nonlinear Control Systems	L	T	P	C
		3	0	0	3
Co-requisite:					
Prerequisite:					
Data Book / Codes/Standards					
Course Category	P				
Course designed by	DEPARTMENT OF EEE				
Approval	-- Academic Council Meeting -- , 2021				

PURPOSE								
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.								
2.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction and Second-order Systems	**9**			
32.	Nonlinear models and nonlinear phenomena; examples	1			
33.	Qualitative behavior of limit systems; multiple equilibria	1			
34.	qualitative behavior of near equilibrium points	2			

35.	limit cycles; numerical construction of phase portraits	1			
36.	existence of periodic orbits; bifurcations	1			
37.	Existence and uniqueness; continuous dependence on initial conditions and parameters	2			
38.	differentiability of solutions and sensitivity; comparison principle	1			
	UNIT-II Lyapunov Stability	**9**			
39.	Autonomous systems; invariance principle	1			
40.	linear systems and linearization; comparison functions	1			
41.	nonautonomous systems	2			
42.	linear time-varying systems and linearization	1			
43.	converse theorems	1			
44.	boundedness and ultimate boundedness	1			
45.	input-to-state stability	2			
	UNIT- III Input-output Stability	**9**			
46.	L stability; L stability of state models; L2 gain	2			
47.	the small-gain theorem	1			
48.	Memoryless functions; state models	2			
49.	positive real transfer functions	1			
50.	L2 and Lypaunov stability	2			
51.	passivity theorems	1			
	UNIT-IV Frequency Domain Analysis	**9**			
52.	Absolute stability; circle criterion	1			
53.	Popov criterion; describing function method	2			
54.	Centre manifold theorem; region of attraction	2			
55.	invariance-like theorems	2			
56.	stability of periodic solutions	2			
	UNIT – V Stabilization	**9**			

57.	Control problems	1			
58.	optimality and limiting behavior; minimum entropy controllers	1			
59.	stabilization via linearization	2			
60.	input-output linearization	2			
61.	full-state linearization	2			
62.	sliding mode control	1			
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	H. K. Khalil, "Nonlinear Systems", 3rd edition, Prentice Hall, 2002
2.	M. Vidyasagar, "Nonlinear Systems", 2nd edition, SIAM, 2002.
3.	A. Isidori, "Nonlinear Control System", 3rd edition, Springer, 1995
4.	S. Sastry, "Nonlinear Systems: Analysis, Stability and Control", Springer, 1999
5.	A. Van der Schaft, "L2-gain and Passivity Techniques in Nonlinear Control", Springer 1996

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Quiz	Assignment	**Total**
	Weightage					
End semester examination Weightage :						