School of Engineering and Applied Sciences

B. Tech Electrical and Electronics Engineering

Syllabus

AY: 2021-2025

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

Semester-I					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EGL 101	Communicative English	3	0	0	3
EEE 101	Fundamentals of Electrical Engineering	3	0	0	3
MAT 112	Single Variable Calculus	3	0	0	3
PHY 101	Engineering Physics	3	0	0	3
PHY 101 L	Engineering Physics Lab	0	0	2	1
CSE 105	Introduction to Programming using C	3	0	0	3
CSE 105 L	Introduction to Programming using C Lab	0	0	2	1
ENV 111	Environmental Science	2	0	0	2
ENV 111 L	Environmental Science Lab	0	0	2	1
ISES 101	Industry Specific Employability Skills	1	1	0	1
	TOTAL	**18**	**1**	**6**	**21**

Semester-II					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
MAT 121	Multi Variable Calculus	3	0	0	3
EGL 121	Critical Thinking –(HS Elective)	4	0	0	4
CSE 107	Data Structures	3	0	0	3
CSE 107 L	Data Structures Lab	0	0	2	1
MAT 221	Probability & Statistics for Engineers	3	0	0	3
PHY 102	Solid State Device Physics	3	0	0	3
PHY 102 L	Solid State Device Physics Lab	0	0	2	1
ENG 111	Basic Electronics	3	0	0	3
ENG 111 L	Basic Electronics Lab	0	0	2	1
ISES 102	Industry Specific Employability Skills II	1	1	0	1
	TOTAL	**22**	**1**	**8**	**23**

Legend:

L - Number of lecture hours per week, T – Number of tutorial hours per week,
P - Number of practical hours per week, C - Number of credits for the course.

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 Circuits Theory	3	0	0	3
EEE 202 L	Electrical Circuits Theory 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
ECE 212	**Open Elective** Signal and Systems	3	0	0	3
ECE 212 L	**Open Elective Lab** Signal and Systems Lab	0	0	2	1
CSE 205	Object Oriented Programming with C++	3	0	0	3
CSE 205 L	Object Oriented Programming Lab	0	0	2	1
MAT 131	Differential Equations	3	0	0	3
ISES 201	Industry Specific Employability Skills-III	1	1	0	1
CSE 230	Industry Standard Coding Practice-1	0	0	4	1
	TOTAL	**19**	**1**	**12**	**25**

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 204	DC Machines and Transformers	3	0	0	3
EEE 204 L	DC Machines and Transformers Lab	0	0	2	1
EEE 205	Computational Techniques in Electrical Engineering	3	0	0	3
PHY 113	BS Elective Field Theory	2	0	2	3
ECE 221	**Open Elective** Analog Electronics	3	0	0	3
ECE 221 L	**Open Elective Lab** Analog Electronics Lab	0	0	2	1
	HS Elective	3	0	0	3
MAT 211	Linear Algebra	3	0	0	3
ISES 202	Industry Specific Employability Skills-IV	1	1	0	1

CSE 330	Industry Standard Coding Practice- 2	0	0	4	1
	TOTAL	**19**	**1**	**10**	**23**

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 303	Power Electronics	3	0	0	3
EEE 303 L	Power Electronics Lab	0	0	2	1
EEE 304	Fundamentals of Power System	3	0	0	3
EEE 305	Advanced Control Systems	2	0	0	2
EEE 305 L	Advanced Control Systems Lab	0	0	2	1
	Open Elective Power Plant Engineering FPGA Programming Object Oriented Programming with C EM Theory and Wave propagation Digital Signal Processing	3	0	0	3
	Technical Elective Renewable Energy Systems	3	0	0	3
ENG 101	Fundamentals of Mechanical Engineering	3	0	0	3
ENG 105 L	Engineering Graphics Lab	0	0	2	1
ISES 301	Industry Specific Employability Skills-V	1	1	0	0
CSE 331	Industry Standard Coding Practice - 3	0	0	4	1
	TOTAL	**21**	**1**	**14**	**26**

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
ECE 313	**Open Elective** Microprocessors and Interfacing	3	0	2	4
EEE 314	**Open Elective** Nuclear Power Generation	3	0	0	3
	Technical Elective Non-Linear systems & Control Switched Mode Power Supply and Resonant Converters	3	0	0	3
EEE 310 P	Undergraduate Research Opportunity Project	0	0	6	3
ECO 121	Principles of Economics	3	0	0	3
ISES 302	Industry Specific Employability Skills-VI	1	1	0	0
	TOTAL	**18**	**1**	**12**	**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 Model 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 (FACTS) Non-Linear Control System Advanced Power Electronics Resonant & Soft Switching Converters	3	0	0	3

	E-Mobility				
TOTAL		**18**	**0**	**4**	**20**

Semester-VII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
EEE 410 P	Project	0	0	16	8

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 101	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.	Course 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 (*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%**

EEE 101	Fundamentals of Electrical Engineering	L	T	P	C
		3	0	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,	2	C		1-3

	reluctance, and permeability.				
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 coefficient of coupling. Inductors in series and parallel, Energy stored in magnetic field.	2	C		1-3
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	2	C, D		1-3

	EMF, Torque equation.				
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%**

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 %**

PHY 101	Engineering Physics	L	T	P	C
		3	0	0	3
Co-requisite:	Single Variable Calculus (MAT 112)				
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 Physics. It mainly includes basic Newtonian mechanics, Waves and oscillations, Introduction to thermodynamics, Electricity & magnetism with General properties of maters.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Apply the fundamental concepts of mechanics such as force, energy, momentum etc. more rigorously as needed for further studies in engineering and technology.							
b.	Students' physical intuition and thinking process through understanding the theory.							
c.	Model simple mechanical systems by correlating it to the real world practical problems.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I - Review of Newtonian Mechanics	**9**			
1.	Introduction to Vector and Coordinate systems.	1	C		1,2,3
2.	Kinematics: Equations of motion for constant acceleration.	1	C-D		1,2,3
3.	Dynamics: Contact forces, Static friction, kinetic friction and worked examples.	1	C-D		1,2,3
4.	Free body force diagram; Applications of Newton's law. Worked examples (i.e. pulley, inclined planes)	1	D-I		1,2,3
5.	Momentum and Impulse, Impulse momentum theorem.	1	C-D		1,2,3
6.	Center of Mass: Calculation of Center of mass for complex systems.	1	D-I		1,2,3
7.	Work and Kinetic Energy Theorem.	1	D-I		1,2,3
8.	Motion at Inclined Plane.	1	C-D		1,2,3
9.	Conservation of linear and angular momenta, worked example (Fly wheel).	1	D-I		1,2,3
	UNIT II – Waves, Oscillations, Optics	**9**			

10.	Simple harmonic motion: simple pendulum, compound pendulum.	1	C		1,2,3, 6
11.	Damped and driven harmonic oscillations, Quality factor; electrical equivalent (LCR circuit).	1	C-D		1,2,3, 6
12.	Circular motion in analogy of Simple Harmonic Motion.	1	C-D		1,2,3, 6
13.	Longitudinal waves, transverse waves; standing waves.	1	C-D		1,2,3, 6
14.	Concept of Electromagnetic waves.	1	D-I		1,2,3, 6
15.	Optics: Interference, diffraction (qualitative).	1	D-I		1,2,3, 6
16.	Double slit interference and concept of coherence length.	1	C-D		1,2,3, 6
17.	Polarization of light (qualitative).	1	C-D		1,2,3, 6
18.	Concept of Lasers.	1	C-D		1, 2, 3, 6
	UNIT III – Classical Thermodynamics	**9**			
19.	Thermodynamic systems and equilibrium: example of ideal gas.	1	C		1, 2, 3
20.	Zeroth law of thermodynamics and concept of temperature.	1	C-D		1, 2, 3
21.	First law of thermodynamics, internal energy and specific heat.	1	D-I		1, 2, 3
22.	Second law of thermodynamics.	1	C-D		1, 2, 3
23.	Entropy, reversibility.	1	C-D		1, 2, 3
24.	Application of 1^{st} and 2^{nd} law of thermodynamics.	1	I		1, 2, 3
25.	Concept of work and free energies.	1	C-D		1, 2, 3
26.	Concept of Phases: Example of phase transitions.	1	C-D		1, 2, 3
27.	Black body radiation – Stefan's law.	1	C		1, 2, 3
	UNIT IV: REVIEW OF ELECTRO-MAGNETISM	**9**			
28.	Properties of charge and Coulomb's law, calculation of electric field and potential	1	C-D		1, 2, 4, 5
29.	Gauss's law (differential and integral form)	1	C-D		1, 2, 4, 5
30.	Application of Gauss's law (line, plane, spherical symmetry)	1	D		1, 2, 4, 5
31.	Dielectrics from the concept of dipole movements in material	1	D		1, 2, 4, 5
32.	Fields in parallel plate capacitor with dielectric medium	1	C-D		1, 2, 4, 5
33.	Biot-Savart Law for magnetic fields, Magnetic field (circular loop).	1	C-D		1, 2, 4, 5
34.	Ampere's circuital law, Examples – Infinite wire and Solenoid.	1	C-D		1, 2, 4, 5
35.	Lenz's Law, Faraday's law.	1	C-D		1, 2, 4, 5
36.	Maxwell's equations	1	C-D		1, 2, 4, 5
	UNIT V: MATERIAL PROPERTIES	**9**			
37.	States of Matter: Solid, Liquid, Gases and Plasma.	1	C		1, 2, 3
38.	Mechanical Properties of solids: linear elasticity (Hooke's Law). Elastic moduli.	1	C-D		1, 2, 3
39.	Shear stress and strain. Rigidity modulus.	1	C-D		1, 2, 3

40.	Moment of Cantilevers: Young's Modulus.	1	C-D		1, 2, 3
41.	Bulk and surface properties of liquid – Adhesion, Cohesion.	1	C-D		1, 2, 3
42.	Surface Tension.	1	C-D		1, 2, 3
43.	Viscosity of liquids.	1	C-I		1, 2, 3
44.	Stoke's equation.	1	C-D		1, 2, 3
45.	Bernoulli's principle (Quantitative).	1	C-D		1, 2, 3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	University Physics with Modern Physics with Mastering Physics - D Young, Roger A Freedman and Lewis Ford, XII Edition (2018), Publisher – PEARSON.
2.	Physics for Scientist and Engineers - Raymond A. Serway, John W. Jewett XIX Edition (2017), Publisher - Cengage India Private Limited.
3.	Concept of Modern Physics - Arthur Besier, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill.
4.	Introduction to Electrodynamics – David J. Griffiths; 4th Edition (2012), Publisher - PHI Eastern Economy Editions.
5.	Electricity and Magnetism - A S Mahajan and A A Rangwala, Revised of 1 Edition (2001), Publisher - McGraw-Hill.
6.	Advanced Engineering Mathematics - Erwin Kreyszig, X Edition (2016), Publisher - Wiley.

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%**

PHY 101 L	Engineering Physics 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 applications related to fundamental formalism of Physics. It mainly includes basic Newtonian mechanics, Waves and oscillations, Introduction to thermodynamics, Electricity & magnetism with General properties of maters.

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 physics to laboratory experiments.							
c.	Origin and analysis of error.							

	Description of Experiments	**Contact hours**	**C-D-I-O**	**IOs**	**Reference**
1a.	Revisions of Vernier caliper and Screw Gauge measurement methods.	1	D-I-O		1, 2
1b.	Plotting experimental data in graphs and error analysis.				
2.	To determine the moment of inertia of a flywheel	1	D-I-O		1, 2
3.	(a) Measurement of time period for a given compound pendulum with different lengths (b) To determine radius of gyration of a given pendulum	1	D-I-O		1, 2
4.	Verification of Stefan`s Law.	1	D-I-O		1, 2
5.	Measurement of specific heat capacity of any given material.	1	D-I-O		1, 2
6.	Verify of Hooke's law and to determine spring contact for given spring combinations.	1	D-I-O		1, 2
7.	To determine the rigidity modulus of steel wire by torsional oscillations.	1	D-I-O		1, 2
8.	To calculate Young's modulus of a given material by deflection method.	1	D-I-O		1, 2
9.	(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.	2	D-I-O		1, 2

10.	(a) Measurement of the induced voltage impulse as a function of the velocity of the magnet. b) Calculation of the magnetic flux induced by a falling magnet as a function of the velocity of the magnet.	1	D-I-O		1, 2
11.	(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.	1	D-I-O		1, 2
12.	(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.	2	D-I-O		1, 2
13.	Study of B-H-Curve To study permeability curve of a given material.	1	D-I-O		1, 2
	Total contact hours (Including demo and repeat labs)	**15**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited)).
2.	Physics laboratory manuals.

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%**

CSE 105	Introduction to Programming Using C	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 Computer Science Engineering				
Approval					

PURPOSE	Formulating algorithmic solutions to problems and implementing algorithms in C.							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux.	A	M					
b.	Understand and implement the concepts of branching, iteration and data representation using arrays.	A	C	M				
c.	Design modular programming and recursive solution formulation.	A	C	M				
d.	Understand pointers and the dynamic memory allocation.	A	C	M				
e.	Understand and apply structure and union.	A	C	M				
f.	Comprehend file operations.	A	C	M				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION	**9**			
1.	Computer systems, hardware and software. Problem solving: Algorithm / Pseudo code, flowchart, program development steps.	1	C	1	2,3
2.	Computer languages: Machine, symbolic and high-level languages.	1	C	1	2,3
3.	Creating and Running Programs: Writing, editing (any editor), compiling (gcc), linking and executing in Linux environment.	1	C	1	2,3
4.	Structure of a C program, identifiers.	1	C	2	2,3
5.	Basic data types and sizes. Constants, Variables.	1	C	2	2,3

6.	Arithmetic, relational and logical operators, increment and decrement operators.	1	C	2	2,3
7.	Conditional operator, assignment operator, expressions.	1	C	2	2,3
8.	Type conversions, Conditional Expressions.	1	C	2	2,3
9.	Precedence and order of evaluation, Sample Programs.	1	C	2	2,3
	Unit II	**9**			
10.	**SELECTION & DECISION MAKING:** if-else, null else, nested if, examples	1	C,D	2	2,3
11.	Multi-way selection: switch, else-if, examples.	1	C,D	2	2,3
12.	**ITERATION:** Loops - while, do-while and for, break, continue	1	C,D,I	2	2,3
13.	Initialization and updating, event and counter controlled loops and examples	1	C,D,I	2	2,3
14.	**ARRAYS:** Concepts, declaration, definition, storing and accessing elements	1	C,D	2	2,3
15.	One dimensional, two dimensional and multidimensional arrays	1	C,D	2	2,3
16.	Array operations and examples.	1	C,D,I	2	2,3
17.	Character arrays.	1	C,D	2	2,3
18.	String manipulations.	1	C,D	2	2,3
	UNIT III – MODULAR PROGRAMMING:	**9**			
19.	Functions – Basics.	1	C,D	3	2,3
20.	Parameter passing.	1	C,D,I	3	2,3
21.	Storage classes extern, auto, register, static, scope rules.	1	C,D	3	2,3
22	User defined functions, standard library functions.	1	C,D,I	3	2,3
23.	Passing 1-D arrays, 2-D arrays to functions.	1	C,D,I	3	2,3
24.	Recursive functions - Recursive solutions for Fibonacci series.	1	C,D,I	3	2,3
25.	Towers of Hanoi.	1	C,D	3	2,3
26.	C Pre-processor .	1	C,D,I	3	2,3
27.	Header files.	1	C	3	2,3
	UNIT IV: POINTERS:	9			
28.	Concepts, initialization of pointer variables.	1	C,D,I	4	2,3
29.	Pointers as function arguments, passing by address.	1	C,D,I	4	2,3

30.	Dangling memory, address arithmetic	1	C,D,I	4	2,3
31.	Character pointers and functions	1	C,D,I	4	2,3
32.	Pointers to pointers,	1	C,D,I	4	2,3
33.	Pointers and multi-dimensional arrays	1	C,D,I	4	2,3
34.	Dynamic memory management functions	1	C,D,I	4	2,3
35.	Command line arguments.	1	C,D	4	2,3
36.	Command line arguments.	1	C,D	4	2,3
	UNIT V:	**9**			
37.	Structures - Declaration, definition and initialization of structures, accessing structures.	1	C,D,I	5	2,3
38.	Nested structures, arrays of structures.	1	C,D,I	5	2,3
39.	Structures and functions, pointers to structures, self-referential structures.	1	C,D,I	5	2,3
40.	Unions.	1	C,D,I	5	2,3
41.	Typeset, bit-fields.	1	C,D	5	2,3
42.	Program applications.	1	C,D	5	2,3
43.	Bit-wise operators: logical, shift, rotation, masks.	1	C,D	5	2,3
44.	**FILE HANDLING**: Concept of a file, text files and binary files, formatted I/O	1	C,D	6	2,3
45.	I/O operations and example programs.	1	C,D	6	2,3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	The C programming Language by Dennis Richie and Brian Kernighan
2.	Problem Solving and Program Design in C, Hanly, Koffman, 7th ed, PEARSON
3.	Programming in C, Second Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education
4.	Programming in C, A practical approach Ajay Mittal PEARSON.
5.	Programming in C, B. L. Juneja, Anith Seth, Cengage Learning.

CSE 105 L	Introduction to Programming Using C 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 Computer Science Engineering				
Approval					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	Basic C programs 1. Calculation of the area of triangle. 2. Find the largest of three numbers using ternary operator. 3. Swap two numbers without using a temporary variable. 4. Find the roots of a quadratic equation. 5. Takes two integer operands and one operator form the user, performs the operation and then prints the result.	2	C	2	4
2.	1. Find the sum of individual digits of a positive integer and find the reverse of the given number. 2. Generate the first n terms of Fibonacci sequence. 3. Generate all the prime numbers between 1 and n, where n is a value supplied by the user. 4. Print the multiplication table of a given number n up to a given value, where n is entered by the user. 5. Decimal number to binary conversion. 6. Check whether the given number is Armstrong number or not.	2	D	2	4
3.	1. Interchange the largest and smallest numbers in the array. 2. Sorting array elements. 3. Addition and multiplication of 2 matrices.	2	D	2	4
4.	1. Function to find both the largest and smallest number of an array of integers. 2. Liner search. 3. Replace a character of string either from beginning or ending or at a specified location.	2	D	2	4
5.	1. Reading a complex number 2. Writing a complex number. 3. Addition of two complex numbers 4. Multiplication of two complex numbers	1		5	4

6.	1. Concatenate two strings 2. Append a string to another string. 3. Compare two strings 4. Length of a string 5. Find whether a given string is palindrome or not	1	D	3	4
7.	1. Illustrate call by value and call by reference. 2. Reverse a string using pointers 3. Compare two arrays using pointers	1	I	3	4
8.	1. To find the factorial of a given integer. 2. To find the GCD (greatest common divisor) of two given integers. 3. Towers of Hanoi.	2	I	3	4
9.	File Operations (File copy, Word, line and character count in a file).	1	I	6	4
10.	Command line arguments (Merge two files using command line arguments).	1	D	6	4
	Total Hours	**15**			

Course nature				**Theory and Lab**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Mid Term I	Mid Term II	Assignments	Lab Performance	Quiz	**Total**
	Weightage Theory	**15%**	**15%**	**5%**	**10%**	**5%**	**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	2	C	2	1,2,3

	forests, Grasslands and desert ecosystems.				
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 101	Industry Specific Employability 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				
Approval					

PURPOSE	To Enhance holistic development of students and improve their competitive skills, life skills and employability skills.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to		D	F	G	I			
1.	Develop interpersonal skills and will be a good team player.							
2.	Develop socializing, positive attitude and behavioral skills.							
3.	Understand their barriers of Communication and will take conscious effort to improve their skill sets.							
4.	Set SMART Goals for themselves and should become better in terms of Time Management							
5.	Learn, practice and acquire the skills necessary to deliver effective presentations with clarity and impact.							
6.	An ability to apply knowledge of mathematics, science and engineering							
7.	An ability to function on multidisciplinary teams							
8.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic							
9.	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: Quants	**11**			
1.	Speed calculations	1	O	5, 6	6, 7
2.	Time and Distance	1.5	O	5, 6	6, 7
3.	Problems on Trains	1	D, I, O	6	6, 7

4.	Boats and Streams	1	D, I, O	5,6	6, 7
5.	Races and Games, Escalator Problems	1	O	5,6	6, 7
6.	Time and Work, Chain Rule, Pipes, and cistern	2	D,I,O	5	6
7.	Simplification, surds and indices, Square roots, and cube roots	2	D,I,O	5	6, 7
8.	Functions	1.5	D,I,O	6	6, 7
	UNIT II – Reasoning	**9**			
9.	Number Series, Alphabet series	1	D,I,	7,8	12
10.	Odd Man Out, Missing number, Wrong number	1	D,I,O	7,8	12,13
11.	Analogies	1	D,,O	7,8	13
12.	Mathematical Operations	1	D,I,O	8	12
13.	Calendars	1	I,O	7	12,13
14.	Clocks	1	I,O	7,8	13
15.	Cryptarithmetic	1	D,I,O	7,8	12,13
16.	Identification of Cross-Variable Relation	1	D,I,O	7,8	12,13
17.	Sudoku	1	D,I,O	7,8	2,13
	UNIT III – Verbal	**13**			
18.	Basic sentence structure: Nouns, Pronouns, Adjectives.	1	O, I	9	10,12
19.	Parts of speech.	1	I	9,10	10,12
20.	Degree of comparison	1	I	10	10,12
21.	Articles, conditionals, and sentences (kinds).	1	I	9,10	10,12
22.	Verb tense.	1	I,O	9	10,12
23.	Sentence formation.	4	O	10	12
24.	Paragraph formation	1	O	9,10	10
25.	Change of voice	0.5	I,O	9,10	10
26.	Change of speech	0.5	I,O	9	10
27.	Synonyms	1	D,I,O	9,10	9, 10

28.	Antonyms	1	D,I,O	9,10	9, 10
	UNIT IV: Communication Skills	**16**			
29.	Self-Introduction	2	D, I	3	4
30.	Presentations	12	D, I	3	4
31.	Email Etiquette	2	O	1, 3, 4	4
	Total contact hours	**49**			

INSTRUCTIONAL OBJECTIVES	
1.	To develop interpersonal skills and be an effective goal oriented team player
2.	To develop professionals with idealistic, practical, and moral values.
3.	To develop communication and problem-solving skills
4.	To re-engineer attitude and understand its influence on behavior
5.	To solve the problems requiring interpretation and comparison of complex numeric summaries.
6.	To develop the ability to sole different problems.
7.	To develop the skills of reasoning.
8.	To develop the knowledge of solving different reasoning problems.
9.	To develop the skills in basics of English.
10.	To develop skills in English vocabulary.

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Mitchell S. Green – 2017, Know Thyself: The Value and Limits of Self-Knowledge
2.	Debbie Hindle, Marta Vaciago Smith - 2013, Personality Development: A Psychoanalytic Perspective
3.	Lani Arredondo - 2000, Communicating Effectively.
4.	Patsy McCarthy, Caroline Hatcher - 2002, Presentation Skills: The Essential Guide for Students.
5.	Martha Davis, Elizabeth Robbins Eshelman, Matthew McKay - 2008, Time Management and Goal Setting: The Relaxation and Stress
6.	Arun Sharma – *How to prepare for Quantitative Aptitude,* Tata McGraw Hill.
7.	Rs Agarwal*, A Modern Approach to Verbal and Non Verbal Reasoning,* S.Chand Publications.
8.	Verbal Ability and Reading comprehension-Sharma and Upadhyay.

9.	Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
10.	GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition
11.	The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication
12.	English grammar and Composition – S.C. Gupta
12.	R.S. Agarwal – Reasoning
13.	Reasoning for competitive exams – Agarwal

ASSESSMENT

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%

SEMESTER II

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%**

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%**

CSE 107	Data Structures	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 CSE				
Approval					

PURPOSE	By the end of this course, students will: ***Understand*** the working principle of various data structures. ***Apply*** the data structures concepts to solve real-world problems. ***Appreciate*** that the theory of complexity analysis is essential in developing efficient (space and time) algorithms to solve real-world problems. ***Appreciate*** that the theory of complexity analysis is essential in developing efficient (space and time) algorithms to solve real-world problems. ***Know*** the effective team functioning, responsibilities, practices and strategies for dealing with non-cooperative team members when group activities are given. Will be able to communicate effectively in both writing and speaking and function effectively in team works.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	**Define** the term Abstract Data Type and explain why we need ADTs							
2.	**Explain** the working principle of the given data structures such as arrays, stacks, queues, linked lists, trees, graphs, etc., with a working example.							
3.	**Use** (applying) the merge-sorting algorithm to sort a given set of elements.							
4.	Given a network communication sub-system in the form of a graph and other necessary details, choose an appropriate data structure to represent the links and nodes in the network, **develop** (cerate) an algorithm to find the shortest path between any two given nodes in the network and simulate the algorithm.							
5.	Given a problem on searching, **determine** the time complexities of the given algorithms: i) searching a key from an unsorted list and ii) searching a key from a sorted list.							
6.	Given a list of algorithms along with their respective asymptotic complexities, **choose** the most efficient one and support your claim with proper justifications.							
7.	**Demonstrate** with an example the limitations of the Array ADT and how this limitation is overcome by using linked-list ADT using structures.							
8.	**Show** effective teamwork practices employed to deal with non-cooperative situations while completing group assignments/tasks.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Data structures	**9**			
1.	Introduction to data structures.	1	C-D-I		1,2
2.	Abstract Data Type (ADT) representation and implementation.	1	C-D-I		1,2
3.	Time and space requirements of algorithms.	1	C-D-I		1,2
4.	Array ADT.	1	C-D-I		1,2
5.	representing polynomials.	1	C-D-I		1,2
6.	Sparse matrices using arrays and their operations.	1	C-D-I		1,2
7.	Implementation of double linked list various operation using C.	1	C-D-I		1,2
8.	Stacks and Queues: Representation and application, implementation of stack and queue operations using C.	1	C-D-I		1,2
	Unit II: Linked Lists	**5**			1,2
9	Single linked lists.	1	C-D-I		1,2
10	Implementation of link list.	1	C-D-I		1,2
11	various operation using C.	1	C-D-I		1,2
12	double linked list.	1	C-D-I		1,2
13	circular list and applications.	1	C-D-I		1,2
	UNIT III – Trees:	**9**	C-D-I		1,2
9.	Tree terminology.	1	C-D-I		1,2
10.	Binary tree.	1	C-D-I		1,2
11.	Binary search tree.	1	C-D-I		1,2
12.	Infix to Post fix conversion.	1	C-D-I		1,2
13.	Postfix expression evaluation.	1	C-D-I		1,2
14.	AVL Tree.	1	C-D-I		1,2
15.	Complete Binary Tree representation.	1	C-D-I		1,2
	UNIT IV: Graphs	**9**			1,2
16.	Graph terminology, Representation of graphs.	1	C-D-I		1,2

17.	Path matrix.	1	C-D-I		1,2
18.	BFS (breadth first search)	1	C-D-I		1,2
19.	Implementation of BFS using C.	1	C-D-I		1,2
20.	DFS (depth first search)	1	C-D-I		1,2
21.	Implementation of DFS using C.	1	C-D-I		1,2
22.	Topological sorting.	1	C-D-I		1,2
23.	Shortest path algorithms.	1	C-D-I		1,2
24.	Priority Queues : Heap Structures, binomial heaps, leftist heaps	1	C-D-I		1,2
	UNIT V: Sorting and Searching techniques	**9**			1,2
25.	Bubble sort	1	C-D-I-O		1,2
26.	Selection sort	1	C-D-I-O		1,2
27.	Insertion sort	1	C-D-I-O		1,2
28.	Quick sort	1	C-D-I-O		1,2
29.	Merge sort	1	C-D-I-O		1,2
30.	Heap sort	1	C-D-I-O		1,2
31.	Radix sort and Implementation	1	C-D-I-O		1,2
32.	Linear and binary search methods, implementation	1	C-D-I-O		1,2
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS [a]/REFERENCE BOOKS [b]/OTHER READING MATERIAL
1[a].	"Data Structure -- A Pseudo code approach with C" by Richard R. Gilberg & Behrouz A. Forouzan, 2nd edition, 2011. Cengage Learning. Imprint: Thomson Press (India) Ltd.
2[a].	Data Structures Using C" by Aaron M. Tanenbaum, Yedidvah Langsam, and Moshe J. Augenstein. Pearson Publishers, 2019.
3[b].	Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson publications, Second Edition Programming in C. P. Dey and M Ghosh, Second Edition, Oxford University Press.
4[b].	Fundamentals of data structure in C" by Horowitz, Sahani & Anderson Freed, Computer Science Press
5[b].	G. A. V. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms" Tata McGraw Hill.

Course nature	**Theory**

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

CSE 107 L	**Data Structures Lab**			**L**	**T**	**P**	**C**
				0	**0**	**2**	**1**
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category		Core Course	Engineering Science				
Course designed by	Department of CSE						
Approval							

Week	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1 & 2	**Simulate the following operations**	**3**			
	a. Conversion of infix expression to postfix expression.	1	C-D-I-O		1
	b. Evaluation of expressions.	1	C-D-I-O		1
	c. Assignment-1: Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the	1	C-D-I-O		1

	following simple rules: i. Only one disk can be moved at a time. ii. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack. iii. No disk may be placed on top of a smaller disk iv. You can choose to use the function move (4, 1, 3, 2), where 4 represents the number of disks. 1 represents disks on source shaft, 3 represents the destination shaft which holds the disks after the move and finally 2 represents the intermediate support shaft – temporary storage. Write a C program to simulate the given problem and: Perform the algorithmic complexity analysis for the solution you propose.				
3 & 4	**Simulate the following tasks:**	**3**	C-D-I-O		2
	a. Implementation of the following operations: enqueue, dequeue and finding an element	1			2
	i. Linear Queue using arrays	1	C-D-I-O		2
	ii.Circular queue arrays	1	C-D-I-O		2
	iii.Priority queue singly linked list	1	C-D-I-O		2
	b. **Assignment-2:** The "4-Queens Problem" consists of placing four queens on a 4 x 4 chessboard so that no two queens can capture each other. That is, no two queens are allowed to be placed on the same row, the same column, or the same diagonal (both primary and secondary diagonals). Write a C program to simulate the given problem and perform the algorithmic complexity analysis for the solution you propose.	1	C-D-I-O		2
5 & 6	**Demonstrate the following though simulation:**	3	C-D-I-O		3
	a. Create a singly linked list and perform the following operations:	1	C-D-I-O		3
	i. Add an element at the end of the list ii. Delete an element from the beginning of the list iii. Find the middle element of the list iv. Search the given key form the list v. Polynomial addition using linked list vi. Sparse matrix operations using linked list	1	C-D-I-O		3
	b. **Assignment-3:** Let us consider a small but busy airport with only one run-way (shown in figure). In each time unit, one plane can land or one plane can take off, but not both. Planes arrive ready to land or to take off at random times, so at	1	C-D-I-O		3

	any given unit of time, the runway may be idle or a plan may be landing or taking off, and there may be several planes waiting either to land or take off. We therefore need two queues, called landing and takeoff, to hold these planes. It is better to keep a plane waiting on the ground than in the air, so a small airport allows a plane to take off only if there are no planes waiting to land. Hence, after receiving requests from new planes to land or take off, our simulation will first service the head of the queue of planes waiting to land, and only if the landing queue is empty will allow a plane to take off. We shall wish to run the simulation through many units of time, and therefore, we embed the main action of the program in a loop that runs for cur-time (denoting current time) from 1 to a variable end-time. Simulate the given scenario using and write the output for different inputs				
7 & 8	**Write code to perform the following operations:**	2	C-D-I-O		
	a. Develop a code to test whether the given tree is binary tree or not. b. Implementation of Binary tree traversals techniques – pre-order, in-order, and post-order. c. Implementation of AVL tree and its operations	1	C-D-I-O		4
	d. Assignment-4: Given a mathematical expression, evaluate it using appropriate tree structure.	1	C-D-I-O		4
9 & 10	**Write the codes to perform the following tasks**	3	C-D-I-O		
	A Implementation of Graph traversals techniques: i) BFS and ii) DFS.	1	C-D-I-O		5
	b. Assignment-5: The **Dijkstra's algorithm** is an algorithm that gives the shortest path between two given vertices of a graph. In this problem we are given a directed graph with each edge having a non-negative weight. Thus, a solution requires a path of many other that costs least. We can think of the problem as like this: think graph G as a map of the airline routes, each node of the graph as the cities and the weights on each edge as the cost of flying from one city to another city. The solution we have to find a routing from a city v to city w such that the total cost is minimum. Write a C program to simulate the given problem. That is find the shortest path between node A and node F in the given graph	1	C-D-I-O		5
11 & 12	Implementation of the following algorithms: **a**. Linear search	1	C-D-I-O		5

	b. Binary search c. Implementation of Bubble sort algorithm d. Implementation of Selection sort algorithm e. Implementations of Merge sort algorithm				
13 & 14	**a.** Implementation of Insertion sort algorithm	1	C-D-I-O		5
	b. Implementation of quick sort algorithm	1	C-D-I-O		5
	c. Assignment-6: Suppose you work at college library. You are in the middle of a quiet afternoon when suddenly a shipment of 3928 different books arrives. The books have been dropped of in one long straight line, but they are all out of order, and the automatic sorting system is broken. To make matter worse, classes will start tomorrow, which means that first thing in the morning, students will show up in droves looking for these books. How can you get them all sorted in time.? Simulate the given scenario using C code. Perform the algorithmic time complexity analysis for the solution you propose. Also give the space complexity.	1	C-D-I-O		5
15	Our Text editor will allow us to read a file into memory i.e., it is stored in the buffer. We consider each line of text to be a string and buffer will be a list of these lines. we shall then devise editing commands that will do list operations on lines in buffer and will do string operations on characters in a single line. Here are few commands; a. R – Read the text file b. W – Write to text file c. I – Insert a new line d. D – Delete the current line e. P – Previous line (back up one line in buffer) f. B – Go to first line of buffer g. E – Go to last line of buffer h. Q – Quit the editor Tasks we do are: a) Receiving a command from user b) Get Command () – this function gets the command from user c) Do Command () – this function performs the command Now we have to perform the command for example if the command is ‘b’ we have to go beginning of buffer; if it is ‘n’ we must move to next line. All these commands can be performed using switch case statement. Using the switch case statements, we check for the command and	1	C-D-I-O		5

	specify the functions to perform the appropriate task. **Reading and Writing Files:** a. Reads the file contents of input file into buffer stopping at the end of file. Here we use some functions List Empty (), Clear List (), Create List (), Insert List (), see the code in the book for better understanding. b. Searching for a String: Here we search for a string from user and informs the user if the target is found or not. c. Changing one string to another: Here we change the string that the user wants to replace from the existing string. If the string is not found user will be informed that string is not found. If found, we should replace the old string with the new string. Perform the algorithmic complexity analysis for the solution you propose.				

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	https://www.youtube.com/watch?v=YstLjLCGmgg
2.	Data Structures and Program Design in C by Robert Kruse, C L Tondo, Bruce Leung and Shashi Mogalla. For pseudocode, refer the following pages 98 to 105. **Online Reference**: https://www.youtube.com/watch?v=xFv_Hl4B83A
3.	Data Structures and Program Design in C by Robert Kruse, C L Tondo, Bruce Leung and Shashi Mogalla. For pseudocode, refer the following pages 139 to 150
4.	Data Structures and Program Design in C by Robert Kruse, C L Tondo, Bruce Leung and Shashi Mogalla. For pseudocode, refer the following pages 510 to 514
5.	Data Structures and Program Design in C by Robert Kruse, C. L. Tondo , Bruce Leung and Shashi Mogalla. For pseudocode, refer the following pages 302 to 312. Online resources: Use the following link to get a better understanding on the problem. https://www.youtube.com/watch?v=PgBzjlCcFvc https://www.programiz.com/dsa/quick-sort

Note :-	
1.	The assignments can be performed in groups (not more than 4 in a group).
2.	**Deliverables:** A report containing the following

3.	1. Title of the problem/program
4.	2. Problem statement and Objective(s) of the problem
5.	3. Working code, without errors.
6.	4. Output written for different input cases.
7.	5. Conclusion: Algorithmic complexity and the problem you faced during the learning to execution stage.

MAT 221	**Probability & Statistics for Engineers**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Co-requisite:	NIL				
Prerequisite:	Permutations and combinations, single and multi-variable calculus				
Data Book / Codes/Standards	NIL				

Course Category	Basic Sciences
Course designed by	Department of Mathematics
Approval	

PURPOSE	This is a first course in probability and statistics mainly for computer science engineering students. Topics include different approaches to probability, conditional probability, random variables, probability distributions, descriptive statistics, linear regression, point estimation, confidence intervals and tests of significance.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
After successfully completing the course, you will have a good understanding of the following topics and their applications:								
a.	After this course, students should be able to understand the compute basic probabilities, formulate a problem using random variables, analyze sample data for possible conclusions about population.							
b.	Students who are interested in becoming statisticians themselves can build a solid foundation in probability and statistics through this course but should plan on additional coursework for thorough and comprehensive preparation.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I – Introduction to Probability	**8**			
1.	Basic principle of counting, multinomial Coefficients.	1	C		1
2.	Axioms of probability, computing probabilities.	3	C		1
3.	Conditional probability, independent events.	2	C		1
4.	Bayes' theorem, law of total probability.	2	C		1
	Unit II- Random variables and distributions	**10**			
5.	Random variables, cumulative distribution function.	1	C		1
6.	Discrete random variables.	1	C		1
7.	Cumulative distribution function and its properties.	1	C		1
8.	Expectation, variance and standard deviation of discrete random variables.	1	C		1
9.	Bernoulli and binomial distributions, their expectations and variances.	1	C		1
10.	Poisson, geometric and negative bi distributions, their expectations and variances.	1	C		1
11.	Continuous random variables.	1	C		1

12.	Expectation and variance.	1	C		1
13.	Uniform and exponential distributions.	1	C		1
14.	Normal distribution.	1	C		1
	Unit III – Joint probability distributions and CLT	**7**			
15.	Joint distribution of two random variables.	2	C		1
16.	Independent random variables and their sum, Central limit theorem.	2	C		1
17.	Student's t-distribution.	1	C		
18.	Covariance and correlation between random Variables.	2	C		1
	Unit IV – Descriptive statistics and linear regression	**10**			
19.	Graphical representation of data -Histograms, scatter plots & time plots.	2	C		1
20.	Descriptive statistics.	2	C		2,3
21.	Correlation – Pearson's correlation coefficient.	3	C		2,3
22.	Linear regression (single & multi-variate).	3	C		2,3
	Unit V – Introduction to statistical inference	**10**			
23.	Population, sample and statistics.	2	C		2,3
24.	Point estimation of parameters.	2	C		2,3
25.	Confidence intervals for population parameters.	2	C		2,3
26.	Tests of significance for population mean.	2	C		2,3
27.	Tests of significance for population proportion.	2	C		2,3

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	S. Ross, A First course in probability, Pearson Education; Ninth edition (2018)
2	M. Baron, Probability and Statistics for computer scientists, Chapman and Hall/CRC; First edition (2006)
3	Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Wiley; Sixth edition (2016)

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%**	**15%**	**15%**	**60%**
End semester examination Weightage :						**40%**

PHY 102	**Solid State Device Physics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
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 Physics. It mainly includes introduction to modern physics, fundamentals of quantum mechanics, solid state physics and devices							
LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Apply the fundamental concepts of modern physics and explain physics phenomenon.							
2.	Students' physical intuition and thinking process through understanding the theory.							

3.	Understand basics of solid state physics and functioning of devices.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – Quantum Mechanics and Application	**9**			
1.	Light as particle: Photoelectric effect, idea of photon.	1	C		1,2,3
2.	Wave particle duality Matter waves - De Broglie hypothesis.	1	C		1,2,3
3.	Postulates of quantum mechanics, Wave function and its physical interpretation.	1	C		1,2,3
4.	Heisenberg's uncertainty principle-qualitative discussion.	1	C		1,2,3
5.	Schrodinger's equation.	1	C-D		1,2,3
6.	Probability current density, Equation of continuity, and its physical significance.	1	C-D		1,2,3
7.	Free particle, Particle in infinitely deep potential well (one - dimension).	1	D		1,2,3
8.	Step potential, Potential barrier (Qualitative discussion). Particle in three dimensional rigid box	1	D		1,2,3
9.	Barrier penetration and tunneling effect.	1	D-I		1,2,3
	UNIT II – Energy Bands and Charge Carriers in Semiconductors	**9**			
10.	Crystal Lattices, Periodic Structures Cubic Lattices its plane and directions.	1	D		1,2,3
11.	Energy bands: Metals - semiconductors and insulators, direct and indirect semiconductors.	1	D		1,2,3
12.	Electrons and holes- intrinsic and extrinsic material, Doped materials - n-type material and p-type semiconductor material.	1	D-I		1,2,3
13.	Electrons and holes in Quantum wells.	1	D-I		1,2,3
14.	The Fermi Level, Electron and hole concentrations at equilibrium, Temperature dependence of carrier concentrations.	1	D		1,2,3
15.	Electrical conductivity and mobility, Drift and resistance, Effects of temperature and doping on mobility.	1	D-I		1,2,3
16.	Carrier Lifetime - Direct recombination, Indirect recombination; Trapping	1	D		1,2,3
17.	Diffusion and drift of Carriers, Built-in electric Fields, Hall effects.	1	D		1,2,3

18.	Diffusion and recombination, The continuity equation.	1	D-I		1,2,3
	UNIT III: PN Junctions	**9**			
19.	Steady state carrier injection; Diffusion length.	1	C		1,2,3
20.	Fabrication of p-n Junctions.	1	C-D		1,2,3
21.	Equilibrium condition of p-n Junctions.	1	C-D		1,2,3
22.	The Contact potential, Equilibrium Fermi levels, Space charge and capacitance of p-n a junction.	1	C-D		1,2,3
23.	Qualitative description of current flow at a forward biased p-n junctions.	1	C-D		1,2,3
24.	Carrier injection from metal contact.	1	D		1,2,3
25.	Reverse-biased p-n junctions; Steady state conditions.	1	D		1,2,3
26.	Zener breakdown and Avalanche breakdown, Voltage rectifiers.	1	D		1,2,3
27.	Metal–Semiconductor Junctions: Schottky Barriers, Rectifying Contacts, Ohmic Contacts.	1	D		1,2,3
	UNIT-IV: Transistors	**9**			
28.	Bipolar Junction and Field Effect Transistor Operation – (BJT and FET) The Load Line, Amplification and Switching.	1	C		1,2,3
29.	The Junction fabrication BJT and FET.	1	C-D		1,2,3
30.	The Metal–Semiconductor FET.	1	C-D		1,2,3
31.	The Metal–Insulator–Semiconductor FET Basic Operation and Fabrication.	1	C-D		1,2,3
32.	The Ideal MOS Capacitor, MOS capacitance –voltage Analysis.	1	D		1,2,3
33.	Time-dependent capacitance measurements, Current–voltage characteristics of MOS Gate Oxides.	1	D-I		1,2,3
34.	MOS Field-effect Transistor - Output characteristics, Transfer characteristics	1	C-D		1,2,3
35.	Short channel MOSFET I–V characteristics, Equivalent circuit for the MOSFET.	1	D		1,2,3
36.	Frequency Limitations of Transistors.	1	D-I		1,2,3
	UNIT V: Optoelectronic Devices	**9**			
37.	Steady State Carrier Generation; Quasi-Fermi Levels .	1	C		1,2,3,4
38.	Photoconductive devices, Current and voltage in an illuminated p-n junction.	1	C-D		1,2,3,4
39.	Solar Cells and Photodetectors.	1	D-I		1,2,3,4

40.	Light-emitting diodes.	1	D		1,2,3,4
41.	Metastable state, Population inversion and Einstein's A and B coefficient..	1	C-D		1,2,3,4
42.	Basic of semiconductor laser	1	C		1,2,3,4
43.	Population Inversion at a Junction, Emission Spectra for p-n junction Lasers.	1	C-D		1,2,3,4
44.	Materials for Semiconductor Lasers, Fabrications.	1	D-I		1,2,3,4
45.	Heterojunction Lasers	1	D		1,2,3,4
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Solid State Electronic Devices - Ben G. Streetman and Sanjay Kumar Banerjee, VII Edition (2015), Publisher – PEARSON
2.	Semiconductor Physics and Devices - Donald A. Neamen, Dhrubes Biswas, V Edition (2012), Publisher – Mc Graw Hill (Indian)
3.	Concept of Modern Physics - Arthur Besier, Shobhit Mahajan, S Rai, 2017 Edition, Publisher - Tata McGraw Hill
4.	Optics - Ajay Ghatak, Fifth Edition (2010), Publisher - Mcgraw Hill
5.	Fiber optics and Lasers: The two revolutions - A. Ghatak, K. Tyagarajan (2006) Publisher -Macmillan

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%**

PHY 102 L	Solid State Device Physics Lab	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	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 application of fundamental formalism of Physics. It mainly includes modern physics, wave and optics, fiber optics, solid state physics.							
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 physics to laboratory experiments.							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Measurement of Planck's constant by Cs photocell.	1	I-O		1, 2
2.	To record the Franck-Hertz characteristic curve for neon emission.	1	I-O		1, 2
3.	Determine charge carrier type and concentration of a given semiconductor using Hall Effect.	2	I-O		1, 2
4.	Four-probe Resistivity Measurement.	1	I-O		1, 2
5.	Circuit Simulation Tutorials for p-n diodes (LTspice).	1	I-O		
6.	Circuit Simulation Tutorials for Zener diodes (LTspice).	1	I-O		
7.	Circuit Simulation Tutorials for Bipolar Junction Transistor (LTspice).	1	I-O		1, 2
8.	Circuit Simulation Tutorials for MOSFET (LTspice).	1	I-O		1, 2
9.	Determination of the beam quality factor (M-parameter) of a given semiconductor laser.	1	I-O		1, 2
10.	To determine the wavelength of a given semiconductor laser lights with the diffraction patterns by single slit and double slit.	1	I-O		1, 2
11.	a) To measure the photo-current as a function of the irradiance at constant voltage	1	I-O		1, 2

	b) Current-voltage and current-load characteristics of a solar cell as a function of the irradiance.				
12.	To determine the wavelength of a semiconductor laser using the Michelson interferometer.	2	I-O		1, 2
13.	a) Determination the wavelength of He-Ne laser using diffraction grating b) Determination the particle size of a given powder.	1	I-O		1, 2
	Total contact hours (Including demo and repeat labs)	**15**			

LEARNING RESOURCES		
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited)).	
2.	Physics laboratory manuals.	

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	1	C	1	2

	Diagrams of Insulators, 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**			
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%**

ISES 102	**Industry Specific Employability 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
6	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 101), 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	1	C		1, 2

		Electrodynamic, Electrostatic & Moving Iron Instrument				
	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 analysis	Project	**Total**
	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 Circuits Theory**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
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 Circuits Theory Lab	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 V: 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 tool**	Lab Performance	Model Exam	Lab Report	Mid 1 Lab Viva	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage : 50%						**50%**

CSE 205	Object Oriented Programming	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Data Structures and Algorithms				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Computer Science and Engineering				
Approval					

PURPOSE	The course aims at providing the object-oriented programming concepts through JAVA Programming. The object-oriented concepts are applied to solve real-time problems in terms of classes and objects. The principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes. Problems are designed using the concepts of packages and interfaces with exception handling and multithreading. The design concepts of real time problems are realized using Graphical User Interface.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	Understand the importance of Object-Oriented Concepts in solving real word problems through Java.	A	B	D	K			
b.	Use the abstract class, inheritance, polymorphism for realizing the re-usability of objects and functions through Java.	A	C	E				
c.	Use the packages and interfaces to re-use students own classes and implement function overriding through Java.	A	B	C	D	E	F	G
d.	Learn to develop GUI applications with controls and event handlers through Java.	I	J	K	L	M	N	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: BASIC OF OBJECT-ORIENTED PROGRAMMING CONCEPTS	**9**			
1.	A way of viewing world – Agents and Communities, messages and methods, Responsibilities, Classes and Instances.	1	C	1-4	1
2.	Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions.	1	C	1	1,2
3.	Summary of Object-Oriented concepts. Java buzzwords, An Overview of Java, Data types, Variables and Arrays, operators, expressions, control statements.	1	C	1	2
4.	Introducing classes, Methods and Classes, String handling.	1	C,D	1	1
5.	Inheritance concept, Inheritance basics, Member access.	1	C	1	2
6.	Constructors, Destructors, Creating Multilevel hierarchy, super uses, using final with inheritance.	1	C	1	1

7.	Polymorphism-ad-hoc polymorphism, pure polymorphism, method overriding.	1	C	1	1
8.	Abstract classes, Object class, forms of inheritance-specialization, specification, construction, extension.	1	C	1	1
9.	Limitation, combination, benefits of inheritance, costs of inheritance.	1	C	1,3	2
	UNIT II – INPUT OUTPUT STREAMS – FILE I/O	**9**			
10.	Stream based I/O(java.io), The Stream Classes-Byte streams and Character streams.	1	C	2,3	1
11.	Reading console Input and Writing Console Output.	1	C	2,3	1
12.	File class, Reading and writing Files.	1	C	1,2,3	1
13.	Random access file operations.	1	C	2,3	1
14.	The Console class.	1	C	1,2	1
15.	Serialization.	1	C	2	1
16.	Enumerations.	1	C	2	1
17.	Auto boxing.	1	C	2	1
18.	Generics.	1	C	2,3	1
	UNIT III – EXCEPTION HANDLING AND MULTI THREADING	**9**			
19.	Fundamentals of exception handling.	1	C	3	2
20.	Exception types, Termination or resumptive models.	1	C	3	2
21.	Uncaught exceptions, using try and catch.	1	C	3	2
22.	Multiple catch clauses, nested try statements, throw, throws and finally.	1	C	3	2
23.	Built- in exceptions, creating own exception sub classes.	1	C	3	2
24.	Multithreading- Differences between thread-based multitasking and process-based multitasking.	1	C	3	2
25.	Java thread model, creating threads.	1	C	3	2
26.	Thread priorities, synchronizing threads, inter thread communication.	1	C	3	2
27.	Inter thread communication.	1	C	3	2
	UNIT IV: THE COLLECTIONS FRAMEWORK (JAVA.UTIL)	**9**			
28.	Collections overview, Collection Interfaces, The Collection classes.	1	C	2	2
29.	Array List, Linked List.	1	C,D	2	2
30.	Hash Set, Tree Set.	1	C,D	3	1
31.	Priority Queue, Array Deque.	1	C,D	3	1

32.	Accessing a Collection via an Iterator, Using an Iterator, The For-Each alternative.	1	C	3	1
33.	Map Interfaces and Classes.	1	C	3	2
34.	Comparators, Collection algorithms.	1	C	3	2
35.	The Legacy Classes and Interfaces- Dictionary, Hash table, Properties, Stack.	1	C	3	2
36.	More Utility classes, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.	1	C	3	2
	UNIT V: GUI PROGRAMMING AND EVENT HANDLING	**9**			
37.	Introduction, limitations of AWT, MVC architecture, components, containers. Understanding Layout Managers, The Delegation event model- Events, Event sources, Event Listeners, Event classes.	1	C,D	4	1
38.	Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes.	1	C,D,I	4	1
39.	A Simple Swing Application, Exploring Swing Controls- JLabel and Image Icon.	1	C,D,I	4	1
40.	JText Field, The Swing Buttons- JButton.	1	C,D,I	4	1
41.	JToggle Button, JCheck Box.	1	C,D,I	4	2
42.	JRadio Button, JTabbed Pane.	1	C,D,I	4	2
43.	JScroll Pane, JList.	1	C,D,I	4	2
44.	JCombo Box, Swing Menus, Dialogs.	1	C,D,I	4	2
45.	Applets – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets. Creating a Swing Applet, Painting in Swing, A Paint example.	1	C,D,I,O	4	2
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2.	Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
3.	An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
4.	Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5.	Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
6.	Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.
7.	Java Programming and Object-oriented Application Development, R. A. Johnson, Cengage Learning

CSE 205 L	Object Oriented Programming Lab	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	Data Structures and Algorithms				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Computer Science and Engineering				
Approval					

Session	Description of Experiment	Contact hours	C-D-I-O	IOs	Reference
1.	Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have	1			

	constructors. Write a function to read the values of the class variables. The values of the variable will be stored in a FILE (text file). The values will be stored in a structured format of your own choice. Further, read the content of the FILE and display the content in an ordered form (First Name, Last Name). Concept Learning: 1. FILE manipulation 2. Use try catch blocks 3. Use multiple try catch block 4. Finally statement				
2.	Create a three classes named Student, Teacher, Parents. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized. Similarly, the other two classes should have run methods with few valid statements under synchronized.	1			
3.	Create two classes named Student and Teacher with required data members. Assume that the information about the Student and Teacher is stored in a text file. Read n and m number of Student and Teacher information from the File. Store the information in Arraylist of type Student and Teacher ArrayList<Student> and ArrayList<Teacher>. Print the information of Teacher who taught OOPS and Maths. Use Iterator and other functions of util in your program.	1			
4.	Watch any of the favorite movie of your choice (any language is fine, preferably English). Create a Text file to store at least 10 meaningful dialogs from the movie and store it in a text file. Process the file to remove the stop words (eg. the, is, was, …….) and 1create another file to have clean text (word). 51.Write a java program to create HashTable to act as a dictionary for the word collection. The dictionary meaning of the words, including synonyms, etc has to be displayed.	1			
5.	Create GUI for the above program to upload the dialog FILE, clean the FILE. The GUI should take input from the user for invoking the dictionary for displaying dictionary meaning.	1			
6.	Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice. Have an option in the GUI to search the name of the students by roll number and display the content in the test field.	1			
7.	Create two classes named Student and Teacher with required data members. Read the information about the student and teacher using text fields. Use checkbox to choose the option to feed either teacher information or student information. Store the information about the Student and Teacher in a text file. Read n and m number	2			

	of Student and Teacher information from the File. Show in the GUI about a Teacher who taught two subjects to a section. Develop at least one of the application (AWT problem) using swing package				
8.	Create a Window based applications using various controls to handle subject registration for exams. Have a List Box to display the subject of semesters. Have one more List box having subject codes. Have a combo box to select the Semester, which will change the list of course and code in the list boxes. Display the subject registered for the examination on the right side of the window.	2			
9.	Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice. Have an option in the GUI to search the name of the students by roll number and display the content in the test field. Develop at least one of the application (AWT problem) using swing package.	2			
10.	Create a Window based application for displaying your photo album. Create a Frame and Canvas. Change the border, foreground and background colors of canvas and other controls. Have buttons to start the image show, pause the image show and end the image show. Explore the options to play background music.	2			
11.	Create a Window application with menu bar and menu. The frame will also have a text area with scroll bar. In the menu, have File related options. Open a file and its content has to be displayed in the text area.	1			
	Total contact hours	**15**			

Course nature		**Theory and Lab**					
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	MID Term I	MID Term II	Assignments	Lab Performance	Quiz	**Total**
	Weightage Theory	**15%**	**15%**	**5%**	**10%**	**5%**	**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%**

ISES 201	Industry Specific Employability Skills-III	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
6.	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
5.	**UNIT-V**	**12**			

6.	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	0	3
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 make students learn about the system modeling, understand their stability aspects, design compensation techniques using time domain and frequency domain methods and finally learn to design PID linear controllers.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	To model, analysis and design of linear feedback control systems.							
b.	To analyze the time response of first and second order systems.							
c.	To investigate the stability of closed loop systems.							
d.	To understand the frequency response approaches for the analysis of linear time invariant (LTI) systems.							
e.	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			1,2,& 3
2.	Objectives of control system, Types of Control Systems, Definition of linear and nonlinear systems.	1			1,2,& 3
3.	Mathematical modelling of Physical Systems –Mechanical Systems.	1			1,2,& 3
4.	Electrical Systems, Electromechanical systems.	1			1,2,& 3
5.	Analogous Systems, Transfer function concept. Properties of Transfer function.	1			1,2,& 3
6.	Block diagram representation of closed loop systems.	1			1,2,& 3
7.	Block diagram algebra.	1			1,2,& 3
8.	Signal Flow graphs, Mason's gain formula.	1			1,2,& 3
9.	Illustrative examples.	1			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			1,2,& 3
11.	Step response of Second Order Systems and its time domain analysis.	1			1,2,& 3
12.	Concept of undamped natural frequency, damping, overshoot, rise time and settling time.	2			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			1,2,& 3
14.	Pole dominance, approximation of higher order systems.	1			1,2,& 3
15.	Error Analysis-Steady state errors in control systems due to step, ramp and parabolic inputs.	1			1,2,& 3
16.	Concepts of system types and error constants.	1			1,2,& 3
17.	Illustrative examples.	1			1,2,& 3
	UNIT- III Stability analysis	**10**			
18.	Concepts of stability, Necessary conditions for Stability.	1			1,2,& 3
19.	Routh stability criterion, Relative stability analysis.	1			1,2,& 3
20.	Introduction to Root-Locus Techniques, The root locus concepts.	1			1,2,& 3
21.	Construction of root loci.	2			1,2,& 3
22.	Introduction to lead, lag and lead-lag compensating networks.	2			1,2,& 3
23.	compensator design with Root locus.	2			1,2,& 3
24.	Illustrative examples.	1			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			1,2,& 3
26.	NY Quist stability criterion.	1			1,2,& 3
27.	Assessment of relative stability gain margin and phase margin.	2			1,2,& 3
28.	Bode Plots.	1			1,2,& 3
29.	Determination of stability with Bode plots, Experimental determination of transfer function.	2			1,2,& 3
30.	Compensator design with Bode plots.	2			1,2,& 3
31.	Illustrative examples.	1			1,2,& 3
	UNIT – V Controller Design	**6**			
32.	Introduction to Controllers, Properties of Controller.	1			1,2,& 3
33.	Classification of Controllers, Proportional Control Mode, Integral Control Mode, Derivative Control Mode.	1			1,2,& 3
34.	Proportional-integral (PI) controller.	1			1,2,& 3
35.	Proportional-derivative (PD) controller.	1			1,2,& 3

36.	Proportional-integral- derivative (PID) controller.	1			1,2,& 3
37.	Tuning rules of Ziegler-Nichols method, Illustrative examples.	1			1,2,& 3
	Total contact hours	**45**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Norman S. Nise, Control Systems Engineering, 6th Edition, John Wiley & Sons Inc , 2010.
2.	M Gopal, Control Systems: Principles and Design, McGraw Hill Education; 4 Edition, 2012.
3.	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 I	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				
Course designed by	Department of Electrical and Electronics Engineering				
Approval					

PURPOSE	To make students learn about the system modeling, understand their stability aspects, design compensation techniques using time domain and frequency domain methods and finally learn to design PID linear controllers.

LEARNING OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
a.	To model, analysis and design of linear feedback control systems.							
b.	To analyze the time response of first and second order systems.							
c.	To investigate the stability of closed loop systems.							

d.	To understand the frequency response approaches for the analysis of linear time invariant (LTI) systems.							
e.	To discuss basic aspects of PID controller design.							

Session	Description of Topic	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	3			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	2			1,2
	Total contact hours				

LEARNING RESOURCES

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

EEE 204	DC Machines and Transformers	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Electrical circuit theory (EEE 202)/ Fundamentals of Electrical Engineering (EEE 102)				
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. GENERAT XING 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:	NIL				
Prerequisite:	Electrical circuit theory (EEE 202)/ Fundamentals of Electrical Engineering (EEE 102)				
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	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.	2			1,2

2.	Load test on separately excited DC generator	2			1,2
3.	To study the characteristics of a dc shunt motor	2			1,2
4.	Speed Control of DC Motor: Field control, Armature control	2			3,4
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	3			3,4
7.	Hopkinson's test on DC shunt machines OC & SC test on single phase transformer	2			3,4
	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

EEE 205	Computational Techniques in Electrical Engineering	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	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%**

PHY 113	**Field Theory**	**L**	**T**	**P**	**C**

		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%**

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	Open Electives				
Course designed by	Department of Electrical and Electronics Engineering				
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								
a.	Develop the ability to understand, analyze and design practical circuits based on BJT and MOSFETs.							
b.	Able to design amplifier circuits using MOSFET and BJT also will be able to understand the frequency response of the amplifiers.							
c.	Understand the effect of positive and negative feedback on different parameters of amplifiers.							
d.	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**	MID Term I	Mid Term II	CLA I	CLA II	**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 Electrical and Communication Engineering				
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								
a.	Develop the ability to understand, analyze and design practical circuits based on BJT and MOSFETs.							
b.	Able to design amplifier circuits using MOSFET and BJT also will be able to understand the frequency response of the amplifiers.							
c.	Understand the effect of positive and negative feedback on different parameters of amplifiers.							
d.	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 Nonstable 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 – Theory Component (Weightage 100%)						
In- semester	**Assessment tool**	MID Term I	Mid Term II	Quiz I	Quiz II	**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%

	Industry Specific Employability Skills-IV	L	T	P	C
		1	1	0	1
	Nil				
	NIL				
s	NIL				
	Skill Building				
	Department of Career Development Centre				

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 Questio				1

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT- II	**8**			
2.	Problem Solving with - Stack Operations, Queue data str Implementation, Linear / Binary Search Algorithms, Sort 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, non linear 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	
	TEXTBOOKS/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	0	3
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, Three phase to two phase conversion (Scott Connection), Tap changing transformers; problems.	4			3&4
	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 develc	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:	NIL				
Prerequisite:	Magnetic circuits, Three-phase transformers				
Data Book / Codes/Standards	NIL				
Course Category	Core				
Course designed by	Department of Electrical Engineering				
Approval					

S. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Brake test on 3-ph squirrel cage Induction Motor	2			1,2
2.	Load test on 3-ph AC slip ring Induction Motor	2			1,2
3.	Load test on 1-ph Induction motor	2			1,2
4.	No–load & Blocked rotor tests on three phase Induction motor	2			1,2
5.	Equivalent circuit of a single phase induction motor	2			1,2
6.	Speed control of induction motor by V/f method	2			1,2
7.	Power factor improvement of single phase induction motor by using capacitors and load test on single phase induction motor	3			1,2
	Total contact hours	**24**			

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 303	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 303 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 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	2			3, 4

Kommentar [S1]:

	distributors with interconnector.				
27.	AC distribution calculations, Methods of solving AC distribution problems.	2			3, 4
28.	3-phase unbalanced loads, Four-wire star-connected unbalanced loads, Ground detectors.	1			3, 4
	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%**

ECE 222	Digital Signal Processing	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	Signals and Systems				
Data Book / Codes/Standards	NIL				
Course Category	MJ Major				
Course designed by	Department of ECE				
Approval					

PURPOSE	The course aims at providing a solid basis in analyzing LTI systems in time and frequency domain. It also introduces analog and digital filters which are the fundamental entities in digital signal processing systems. All these concepts will be understood by active laboratory participation.

LEARNING OBJECTIVES		STUDENT OUTCOMES						
At the end of the course, student will be able to								
1.	Analyze and determine the response of an LTI system in both time and frequency domain.							
2.	Know what are different kind of analog filters to be used as anti-aliasing filters and smoothing filters along with thorough understanding and comparison.							
3.	Design of IIR and FIR digital filters that operate on discrete-time signals. This also involves deriving digital filters from analog prototypes along with filter transformations							
4.	Multi-rate signal processing will be introduced along with few implementation techniques. Learners will get though understanding with MATLAB implementations.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Review of signals and systems	**9**			
1.	Types of Signals, Transformation of signals	2	C		3
2.	LTI system properties, Linear Convolution	2	C-D-I		3
3.	Linear Correlation, Sampling Theorem	2	C-D-I		3
4.	Discrete Time Fourier Transform, properties.	2	C-D		3
5.	Z-Transform Basics	1	C-D		3
	UNIT II– Discrete Fourier Transform	**9**			
6.	Discrete Fourier transform (DFT), Properties of DFT	2	C-D		1,2
7.	circular convolution, circular correlation, DIT FFT Algorithm	3	C-D-I		1,2

8.	DIF FFT Algorithm, Linear Filtering based on DFT	2	C-D-I		1,2
9.	Rader's Overlap-save method, Overlap-add method	2	C		1,2
	UNIT III-Implementation of Discrete-Time Systems	**9**			
10.	Introduction to FIR and IIR systems	1	C		1,2
11.	Structures for realizing of discrete time systems	1	C-D		1,2
12.	Structures for FIR and IIR Systems	1	C-D		1,2
13.	Signal Flow Graphs	1	C-D		1,2
14.	Direct Form I and Direct Form II Methods	1	C-D		1,2
15.	Cascade Form, Parallel Form	1	C-D		1,2
16.	Lattice Structures	1	C-D		1,2
17.	Transposed Strucures	1	C-D		1,2
18.	Linear Phase FIR Filter	1	C-D		1,2
	UNIT IV: Digital Filters	**9**			
19.	General considerations – causality and its implications	2	C-D		1,2
20.	Characteristics of practical frequency selective filters IIR filter design	2	C-D		1,2
21.	Discrete time IIR filter (Butterworth and Chebyshev) from analog filter	2	C-D-I		1,2
22.	IIR filter (LPF, HPF, BPF, BRF) design by Impulse Invariance	2	C-D-I		1,2
23.	Bilinear transformation, Approximation of derivatives	1	C-D		1,2
	UNIT V: Multi-rate Signal Processing	**9**			
24.	Decimation, Interpolation	2	C-D-I		1,2
25.	Sampling rate conversion of non-integer factors	2	C-D-I		1,2
26.	Multi stage implementation and polyphase implementation of decimation and interpolation	3	C-D		1,2
27.	Digital filter banks, applications of multirate signal processing	2	C-D		1,2
	Total contact hours	45			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	"Discrete-time signal processing" by A. Oppenheim and R. W. Schafer, Pearson, 2014 edition.
2.	"Digital Signal Processing" by J. G. Proakis and D. G. Manolakis, 2007 edition, Pearson India.
4.	"Signals and Systems" by Oppenheim, Wilsky and Nawab, Prentice Hall, 2nd edition. ISBN: 9780138147570.

ECE 222 L	LABORATORY: DIGITAL SIGNAL PROCESSING	L	T	P	C
		0	0	2	1
Co-requisite:	NIL				
Prerequisite:	Signals and Systems				
Data Book / Codes/Standards	NIL				
Course Category	MJ				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The purpose of lab experiments is also to use the MATLAB as a simulation software tool. This course mainly enables the students to gain sufficient knowledge on implementation of different topics in Digital Signal Processing.

LEARNING OBJECTIVES		STUDENT OUTCOMES
At the end of the course, student will be able to		
1	Implement the signal processing topics in MATLAB	
2	Analyze the FFT algorithms, analog and digital filters using MATLAB	

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	Reference
1	Obtain linear convolution of two finite length sequences	1	I, O		1-3
2	Obtain DFT / IDFT of given Discrete Time signals	1	I, O		1-3
3	Obtain circular convolution of two finite length sequences	1	I, O		1-3
4	Obtain linear correlation and circular correlation of two finite length sequences	1	I, O		1-3
5	Implementation of FFT of given sequence	1	I, O		1-3
6	Implementation of Butterworth Low Pass Filter	1	I, O		1-3
7	Implementation of Chebyshev Low Pass Filter	2	I, O		1-3
8	Implementation of High Pass IIR filter for a given sequence	2	I, O		1-3
9	Implementation of Low Pass FIR filter for a given sequence	2	I, O		1-3
10	Implementation of Low Pass IIR filter for a given sequence	2	I, O		1-3
11	Implementation of Decimation	1	I, O		1-3
12	Implementation of Interpolation	1	I, O		1-3
	Total contact hours (Including demo and repeat labs)	**16**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1	Oppenheim, Alan V., John R. Buck, and Ronald W. Schafer. *Discrete-time signal processing. Vol. 2*. Upper Saddle River, NJ: Prentice Hall, 2001.

2	Mitra SK, Kuo Y. Digital signal processing: a computer-based approach. New York: McGraw-Hill; 2006 Feb.

EEE 305	ADVANCED CONTROL SYSTEMS	L	T	P	C
		2	0	0	2
Co-requisite:	NIL				
Prerequisite:	Differential Equations (MAT 131), 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.	Develop compensators and linear feedback controllers for linear time invariant systems							

2.	Discuss state variable approach for linear time invariant systems in continuous time domain. 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 Feedback control design	**6**			
1.	Lag compensator design using root locus.	1			1 & 2

2.	Lead compensator design using root locus.	1			1 & 2
3.	Lag-lead compensator design using root locus.	1			1 & 2
4.	Proportional, derivative and integral control action.	2			1 & 2
5.	PID controller tuning rules. Ziegler-Nichols method.	1			1 & 2
	UNIT-II Compensator design using root locus	**10**			
6.	Analysis in state-space: A perspective on state-space design.	1			1 & 2
7.	State variables. State models for physical systems.	1			1 & 2
8.	SISO and MIMO systems.	1			1 & 2
9.	Solution of state equations. Transfer. function.	1			1 & 2
10.	Eigenvalues and eigenvectors.	1			1 & 2
11.	Jacobian linearization technique.	1			1 & 2
12.	State transformations and diagonalization	1			1 & 2

13.	Transformation to phase-variable canonical form.	1			1 & 2
14.	Controllability and observability.	1			1 & 2
15.	Duality property.	1			1 & 2
	UNIT- III Pole Placement Design and State Observers	**7**			
16.	Introduction.	1			1 & 2
17.	Stability Improvements by State Feedback.	1			1 & 2
18.	Necessary and Sufficient Conditions for Arbitrary Pole Placement.	1			1 & 2
19.	State Regulator Design, Design of State Observer.	2			1 & 2
20.	Compensator Design by the Separation Principle.	2			1 & 2
	UNIT-IV Non-linear Systems Analysis	**9**			
21.	Introduction.	1			1& 2
22.	Common Nonlinear System Behaviors.	1			1 & 2

23.	Common Nonlinearities in Control Systems, Fundamentals.	1			1 & 2
24.	Describing Functions of Common Nonlinearities.	1			1 & 2
25.	Stability Analysis by Describing Function Method.	1			3
26.	Concept of Phase Plane Analysis, Construction of Phase Portraits.	1			3
27.	System Analysis on the Phase Plane.	1			3
28.	Simple Variable Structure Systems, Lyapunov Stability Definitions.	1			3
29.	Lyapunov Stability Theorems, Lyapunov Functions for Nonlinear Systems.	1			
	Total contact hours	**32**			

LEARNING RESOURCES	
	TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	"Control Systems Engineering" (For the Modules 1 and 2) I.J. Nagarath and M.Gopal New Age, 5th Edition, 2007.

2.	“Modern Control Engineering,” K.Ogata, Pearson Education Asia/ PHI,4 th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
3.	“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 I	CLA II	**Total**
	Weightage	**15%**	**15%**	**10%**	**10%**	**50%**
End semester examination Weightage :						**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.							

Sl. No	Description of Experiments	Contact hours	C-D-I-O	IOs	References
1.	DC Motor modeling using LabVIEW	1			1 & 2
2.	Speed control of DC Motor	1			1 & 2
3.	Position control of DC Motor	2			1 & 2
4.	Inverted pendulum control	2			1 & 2
5.	Characteristics of Brushed and Brushless DC motor	2			1 & 2
6.	Speed control of stepper motor	1			1 & 2
7.	Position control of servo motor	2			1 & 2
8.	Tuning of PID controller gains for closed loop converter control	2			1 & 2

9.	Control system design for power systems	2			1 & 2
	Total contact hours (Including demo and repeat labs)	**15**			

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

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	**8**			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.	1			1,2
5.	Zeroth law of thermodynamics, concept of temperature.	1			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.	1			1,2

	Carnot cycle, Carnot theorem, Clausius theorem, Concept of entropy.				
	UNIT II – HEAT ENGINES	**8**			1,2
8.	Classification of energy sources, Introduction to fuels and combustion, Classification of fuels, calorific value, Global warming	1			1,2
9.	Thermal prime movers, elementary heat engines, working substances, classification of heat engines.	1			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	**2**			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.	1			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	**40**			

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%**

ENG 105 L	Engineering Graphics 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 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 301	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

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

	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**	Mid Term test I	Mid Term test II	**Total**

	tool			
	Weightage	**25%**	**25%**	**50%**
End semester examination Weightage: 50%				**50%**

SRM UNIVERSITY AP
Andhra Pradesh

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
		2	0	2	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 excitatic Effect of change in prime mover torque, Influence governors on load division between parallel units	9			3&4
	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%**

\

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	Engineering Science				
Course designed by	Department of ECE				
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								
a.	To study and understand the architecture of 8085 microprocessor.							
b.	To study and understand the architecture of 8086 microprocessor.							
c.	To learn and understand design aspects of I/O and interfacing devices.							
d.	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	3	C-D-I-O		1, 2, 3

	with elevator. (e) ALP to interface 8086 with DDAC.				
	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.

Course nature				**Theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Lab Performance	Model Exam	Observation Note		**Total**
	Weightage	**5%**	**10%**	**5%**		**20%**
End semester examination Weightage : 15%						**15%**

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 taxation.	1	C	2	1,2,3
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 MAKET	**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 VI:	**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.
3.	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%**

ISES 302	**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			
9.	GD	3	C and I		5
10.	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	2	4
Co-requisite:	NIL				
Prerequisite:	1. EEE 301 AC Machines 2. EEE 304 Fundamentals of 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 faults 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	2	4
Co-requisite:	Switchgear and Protection (EEE 403)				
Prerequisite:	Fundamentals of Power Systems (EEE 304) Field Theory –TE 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,	1	C		1-3

	partial discharge				
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 material using impedance analyzer	1			
	Total contact hours	**15**			

OPEN Electives

ECE 411	Embedded Systems and RTOS	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.Slosset*al*.,"*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 Design**	**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.	)b 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 Design 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 pulse converters.	1			
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 monitoring, assessment of voltage and current unbalance, examples of application	1			
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								
a)	Get an overview of pulse power systems including energy storage devices, voltage multiplier circuits							
b)	Understand the insulation aspects of pulse power systems							
c)	Understand the different types of high-power switches							
d)	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 :	