



School of Engineering and Applied Sciences
B. Tech Electrical and Electronics Engineering

AY: 2018-2022

Syllabus

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

Semester-I					
Course Code	Course Name	L	T	P	C
ENL 101	Communicative English	3	0	0	3
BIO 101	Introduction to Biology	2	0	2	3
MAT 112	MATHEMATICS - I	3	0	0	3
CSE 102	Basic Computer Science and Programming	3	0	2	4
ENG 111	Basic Electronics	3	0	2	4
PHY 112	Classical Mechanics	2	0	2	3
CDC 111	Soft Skills-I	1	0	0	1
TOTAL		17	0	8	21

Semester-II					
Course Code	Course Name	L	T	P	C
EEE 101	Introduction of Electrical Engineering	2	1	2	4
CSE 223	Data Structures and Algorithms using C	3	0	2	4
CHE 101	Principles of Chemistry	2	0	2	3
PHY 221	Electricity and Magnetism	2	0	2	3
ECO 121	Principles of Economics	3	0	0	3
MAT 121	Multi Variable Calculus	3	0	0	3
CDC 102	SOFT SKILLS - II	1	0	0	1
TOTAL		16	1	8	21

Semester-III					
Course Code	Course Name	L	T	P	C
EE 201	Electrical and Electronics Measurement	2	1	0	3
EE 202	Electrical Circuit Analysis	2	1	0	3
ECE 211	Open Elective Digital Electronics	3	0	2	4
ECE 212	Open Elective Signals and Systems	3	0	2	4
MAT 131	Differential Equations	3	0	0	3
ENG 101	Engineering Fundamentals	3	0	0	3
CDC 204	Quantitative Aptitude	1	0	0	1
TOTAL		17	2	4	21

Semester-IV					
Course Code	Course Name	L	T	P	C
EEE 203	Control Systems Design	2	1	2	4
EEE 204	DC Machines and Transformers	3	0	2	4
EEE 205 P	UROP	0	0	6	3
ECE 221	Open Elective Analog Electronics	3	0	2	4
MAT 211	Linear Algebra	3	0	0	3
ENG 105 L	Engineering Graphics Lab	0	0	2	1
CDC 203	Verbal Ability	1	0	0	1
CSE 230	INDUSTRY STANDARD CODING PRACTICE - I	0	0	4	1
TOTAL		12	1	20	21

Semester-V					
Course Code	Course Name	L	T	P	C
EE 301	AC Machines	3	0	2	4
EE 304	Fundamentals of Power System	3	0	2	4
EE 305	Advanced Control Systems Design	2	0	2	3
PHY 113	Open Elective Field Theory	3	0	0	3
ECE 313	Open Elective Microprocessors and Interfacing	3	0	2	4
EE 303	Technical Elective Numerical Methods	3	0	2	4
CDC 331	Employability Skills	1	1	0	0
CSE 330	Industry Standard Coding Practice-2	0	0	4	1
TOTAL		18	1	14	23

Semester-VI					
Course Code	Course Name	L	T	P	C
EEE 306	Power System Analysis	3	0	2	4
EEE 308	Power Electronics	3	0	2	4
EEE 309	Synchronous Machines	2	0	2	3
EEE 310 P	Multi-Disciplinary Design project	0	0	6	3
EEE 314	Open Elective Nuclear Power Generation	3	0	0	3
EEE 311 EEE 312	Technical Elective Non-Linear Systems & Control Renewable Energy Systems	3	0	0	3
ENV 111	Environmental Science	2	0	2	3
ISES 312	Industry Specific Employability Skills VI	1	1	0	0
CSE 331	Industry Specific Coding Practice 3	0	0	4	1
TOTAL		17	1	18	24

Semester-VII					
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Course Code	Course Name	L	T	P	C
EEE 403	Switch Gear and Protection	3	0	2	4
EEE 404	High Voltage Engineering	3	0	2	4
	Open Elective Embedded Systems VLSI Microwave theory and applications 3D Printing	3	0	0	3
	Technical Elective Electrical Machine Design HVDC System modeling and Identification Power Quality	3	0	0	3
	Technical Elective Computer Techniques in power systems	3	0	0	3
	Technical Elective Pulsed power system Flexible AC transmission system (FACTS) Nonlinear control system Utilization of electric power Advanced power electronics Resonant & soft switching converters E-Mobility	3	0	0	3
	Humanities Elective	3	0	0	3
TOTAL		21	0	4	23

Semester-VIII					
Course Code	Course Name	L	T	P	C
EE 410 P	Project	0	0	20	10
TOTAL		0	0	20	10

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

SEMESTER- I

ENL 101	Communicative English	L	T	P	C
		3	0	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	Humanity Sciences				
Course designed by	Department of English				
Approval					

PURPOSE	To develop the ability in the engineering student, to be able to communicate in simple English.						
INSTRUCTIONAL OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to apply concepts of							
a)	How to speak simple English/spoken			a	e		
b)	How to communicate to customers, vendors, teachers, students			a	e		
c)	How to do presentation using plain English			a	e		
d)	How to communicate on phone, skype			a	e		
e)	How to understand accents, phonetics			a	e		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: RHETORIC AND PUBLIC SPEAKING	12			
1.	Rhetoric	3	C,D	1	1,2
2.	Critical thinking and public speaking	3	C,D	1	1,2
3.	Thinking outside the box	3	C,D	1	1,2
4.	How to deliver a speech	3	C,D	1	1,2
5.	Fundamentals of persuasion	1	C,D	1	1,2
	UNIT II: NON VERBAL COMMUNICATION	12			
6.	Nonverbal communication	3	C,D	2	1,2
7.	Spatial distance	3	C,D	2	1,2
8.	Eye contact and appearances	3	C,D	2	1,2
9.	How nonverbal communication is important	3	C,D	2	1,2
	UNIT III: COMMUNICATION AND THE MEDIA	12			

10.	Persuasion and the media	3	C,D	3	1,2
11.	Radio, television, film	3	C,D	3	1,2
12.	Social media and the internet	2	C,D	3	1,2
13.	How the media sells the ideas, images, products	3	C,D	3	1,2
14.	Informative/scientific speeches and research	2	C,D	3	1,2
15.	Heart of the speech, powerful narratives	1	C,D	3	1,2
16.	Power of narrative	1	C,D	3	1,2
	UNIT IV: SMALL GROUP COMMUNICATION	12			
17.	Leadership, conflict and persuasion in group	2	C,D	4	1,2
18.	Importance of small groups in business	2	C,D	4	1,2
19.	Moment of Inertia by analytical method	2	C,D	4	1,2
20.	Group problem solving	2	C,D	4	1,2
21.	Learning to say no	3	C,D	4	1,2
	Total contact hours*	48			

*Excluding assessment hours

LEARNING RESOURCES	
Sl No.	TEXTBOOKS
1.	Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, Sixth Edition, Pearson Publishing.
REFERENCE BOOKS/OTHER READING MATERIAL	
2.	Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition
3.	The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

Course nature			Theory			
Assessment Method (Weightage 100%)						
In-semester	Assessment tool	Mid Term I	Mid Term II	CLA 1	CLA 2	Total
	Weightage	10%	15%	5%	5%	50%
End semester examination Weightage: 50%						50%

BIO 101	Introduction to Biology	L	T	P	C
		2	0	2	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Basic Sciences				
<i>Course designed by</i>	Department of Biology				
<i>Approval</i>					

PURPOSE	The course aims at providing to introduce the concept of basic biology and hands-on experiments to biological experiments. The course aims to increase understanding of living system and its interaction with the environment. The aim of the course is to acquire knowledge, conceptual understanding and skills to solve problems and make informed decisions in scientific and other contexts.						
LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							
1. Understand the importance of biological science.							
2. Identify the characteristics and basic needs of living organisms and ecosystems.							
3. To provide thorough training in written and oral communication of scientific information.							
4. Understand the structure and function of prokaryotic and eukaryotic cells, as whole entities and in terms of their subcellular processes.							

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: BASIS OF LIFE AND DIVERSITY	9			
1.	Molecular evolution.	1	C	1-4	3,8
2.	Elements to molecules: water, carbohydrates.	1	C	1	3.8
3.	Carbohydrates and lipids.	1	C,D	1	1,5,8
4.	Lipids and proteins.	1	C,D	1	1,5,8
5.	Nucleic acids, vitamins and minerals.	1	C	1	1,5,8
6.	Diversity of life: virus, bacteria, archea and eukarya.	1	C	1	5
7.	Concept of terrestrial, aquatic and amphibians.	1	C,D	1	11.12
8.	Mode of energy & carbon utilization-autotrophs.	1	C	1	5
9.	Mode of energy & carbon utilization-hetero and lithotrophs.	1	C	1,3	5
	UNIT II – CELL BIOLOGY	9			

10.	Cell: morphology.	1	C	2,3	3,4,10
11.	Cell organelles and functions.	2	C,D	2,3	3,4,10
12.	Concept of unicellular and multicellular organisms.	1	C	2,3	3,4,10
13.	Cell cycle and cell division.	1	C	1,2	3,4,10
14.	Mitosis.	1	C,D	2	3,4,10
15.	Meiosis.	1	C	2	3,4,10
16.	Basis of cell-cell communication and signaling.	2	C,D,I	2	3,4,10
	UNIT III – MOLECULAR BIOLOGY	9			
17.	DNA and Chromosomes: structure and organization.	2	C,D	3	1,6,7
18.	DNA replication.	2	C	3	1,6,7
19.	Transcription.	2	C	3	1,6,7
20.	Translation.	2	C	3	1,6,7
21.	Introduction to genetic engineering.	1	C,D	3	1,6,7
	UNIT IV: ENZYMES AND APPLICATIONS	9			
22.	Introduction to enzymes; classification.	1	C	2	2,5,9
23.	Parameters influencing the enzyme activity.	2	C,D	2	2,5,9
24.	Mechanism of enzyme action.	2	C	3	2,5,9
25.	Commercial applications of microorganisms and enzymes.	2	C,D	3	2,5,9
26.	Commercial applications of microorganisms and enzymes.	1	C,D	3	2,5,9
	UNIT V: BIOLOGICAL SEQUENCES AND DATABASES	9			
27.	DNA and Protein sequences.	2	C,D	4	4,6,7,12
28.	Concept of genomics, transcriptomics, proteomics and metabolomics.	2	C	4	4,6,7,12
29.	File formats of sequence storage: FASTA file, GenBank.	1	C	4	4,6,7,12
30.	Biological databases – NCBI and EMBL browsers.	1	C,D	4	4,6,7,12
31.	Biological databases –KEGG and UniProt databases.	1	C,D	4	4,6,7,12
32.	Usefulness of biological metadata-Array expression and 1000 genomes.	1	C	4	4,6,7,12
33.	Application of BLAST and Protein/Gene ID conversion.	1	C,D	4	4,6,7,12
	Total contact hours	45			

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Isolation of starch from potato.	1			
2.	Estimation of carbohydrates.	1			
3.	Determination of enzyme activity (amylase assay).	2			
4.	Observation of various stages of mitosis in onion root tips.	2			
5.	Isolation, purification and observation of microbes from different sources.	1			
6.	Microbial gram staining.	2			
7.	Purification of DNA, restriction digestion, agarose gel electrophoresis and visualization.	2			
8.	Isolation of proteins and determination of protein concentration using Bradford's method.	2			
9.	Separation of proteins using SDS-PAGE and Coomassie staining.	2			
	Total Hours	15			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Thrives in Biochemistry and Molecular Biology, Edition 1, 2014, Cox, Harris, Pears, Oxford University Press
2.	Exploring Proteins, Ed. 1, 2014, Price and Nairn, Oxford University Press.
3.	Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University Press.
4.	Cooper, G. M., Hausman, R. E. The cell: a molecular approach. (2009). ASM Press, Washington D. C.
5.	Lehninger, A. L., Nelson, D. L., & Cox, M. M. Lininger principles of biochemistry. (2000). Worth Publishers, New York.
6.	Wilson, K., Walker, J. Principle and techniques of biochemistry and molecular biology, (2005). 6th edn. Cambridge University Press, Cambridge.
7.	Harvey Lodish, Arnold Berk and Chris A. Kaiser, Molecular Cell Biology, Ed. 8, 2016, W. H Freeman & Co (Sd).
8.	Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. 2014. Molecular Biology of the Cell. (Sixth Edition). W. W. Norton & Company.
9.	Scott Freeman, Kim Quillin, Lizabeth Allison, Michael Black, Emily Taylor, Greg Podgorski and Jeff Carmichael. 2016. Biological Science. (6th Edition). Pearson.
10.	Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Robert and Peter Walter. 2014. Essential Cell Biology. (4th Edition). W. W. Norton & Company.
11.	Lisa A. Urry , Michael L. Cain , Steven A. Wasserman , Peter V. Minorsky , Jane B. Reece. 2016. Campbell Biology (11th Edition). Pearson.
12.	Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos and Susan Singer. 2016. Biology. (11th Edition). McGraw-Hill Education.

Course nature				Theory and Lab			
Assessment Method (Weightage 100%)							
In-semester	Assessment tool	Mid Term I	Mid Term II	CLA 1	Lab Performance	CLA 2	Total
	Weightage Theory	15%	15%	5%	10%	5%	50%
End semester examination Weightage: 50%							50%

MAT - 112	MATHEMATICS - I	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	Calculus is a foundational course it plays an important role in the understanding of science, engineering, economics, and computer science, among other disciplines. This introductory calculus course covers differentiation and integration of functions of one variable, with applications.						
LEARNING OBJECTIVES						STUDENT OUTCOMES	
After completing this course, students should demonstrate competency in the following skills:							
1.	Use both the limit definition and rules of differentiation to differentiate functions.						
2.	Sketch the graph of a function using asymptotes, critical points, the derivative test for increasing/decreasing functions, and concavity.						
3.	Apply differentiation to solve applied max/min problems.						
4.	Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.						
5.	Apply integration to compute arc lengths, volumes of revolution and surface areas of revolution.						
6.	Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.						
7.	Determine the convergence/divergence of an infinite series and find the Taylor series expansion of a function near a point.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Limit and Continuity	9			
1.	Limit of a function at a point.	3	C		1
2.	One-sided limits.	2	C		1
3.	Continuity.	2	C		1
4.	Limits involving infinity.	2	C		1
	Unit II: Differentiation	9			
5.	Derivative at a point.	2	C		1
6.	Derivative as a function.	2	C		1
7.	Product rule, Quotient rule and chain rule.	2	C		1

8.	Implicit differentiation.	1	C		1
9.	Rolle's Theorem.	1	C		1
10.	Mean Value Theorem.	1	C		1
	Unit III: Integration	9			
11.	Area as a limit of finite sums.	1	C		1
12.	Definite and indefinite integral.	2	C		1
13.	Fundamental Theorem of Calculus.	1	C		1
14.	Integration by substitution.	2	C		1
15.	Integration by parts.	1	C		1
16.	Integration by partial fractions.	2	C		1
	Unit IV: Application of Calculus	9			
17.	Maxima and minima.	1	C		1
18.	Concavity and curve sketching.	1	C		1
19.	Optimization problems in Physics.	1	C		1
20.	Economics & Mathematics.	1	C		1
21.	Area between curves.	2	C		1
22.	Volumes, Arc length, Moments and centers of mass.	2	C		1
23.	Newton's method to find roots.	1	C		1
	Unit V: Sequence and Series	9			
24.	Sequences, Sum of a series.	2	C		1
25.	Comparison test, Root test, Ratio test.	2	C		1
26.	Leibniz theorem on alternating series.	2	C		1
27.	Power series, Taylor's and Maclaurin series.	2	C		1
28.	Absolute and conditional convergence.	1	C		1
	Total Hours	45			

LEARNING RESOURCES

TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1.	Thomas' Calculus, 14th Edition, Joel R. Hass, Christopher E. Heil, Maurice D. Weir, 2018.
2.	Introduction to Real Analysis 4th Edition, Robert G. Bartle, Donald R. Sherbert, 2014.
3.	Calculus and Analytic Geometry, 9 th Edition, George B. Thomas, Jr. Ross L. Finney. 2017.

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%	

CSE 102	Basic Computer Science and Programming	L	T	P	C
		3	0	2	4
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of CSE				
Approval					

PURPOSE	The course aims to provide ability to design algorithmic solutions to problems and convert algorithms to Python programs. Design modular programs using functions and develop recursive solutions. Provide ability to design programs with interactive input and output, utilizing arithmetic expression repetitions, decision making and design object-oriented solutions. To analyses the computational complexity of the programs.
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LEARNING OBJECTIVES		STUDENT OUTCOMES							
At the end of the course, student will be able to									
1.	To learn basics of programming knowledge in Python.								
2.	The course is designed to get the knowledge of developing problem solving skills using Python.								
3.	Decision making and functions in python.								
4.	To introduce basic concepts of object-oriented design technique.								
5.	To introduce the concept of computational complexity.								

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

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

	UNIT V:	9			
35.	Computational Complexity:	1			2
36.	Program Efficiency, Big Oh Notation.	1			2,4
37.	Complexity Classes Analyzing Complexity.	1			2
38.	Searching and Sorting Algorithms:	1			2,4
39.	Introduction on search and sorting.	1			
40.	Linear Search.	1			
41.	Bisection Search.	1			
42.	Bogo and Bubble Sort.	1			
43.	Selection Sort, Merge Sort.	1			
	Total contact hours	45			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)
2.	Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
3.	Data Structures and Algorithms in Python by Michael T Goodrich and Roberto Tamassia, Micheal S Goldwasser, Wiley Publisher (2016)
4.	Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition(6 th February 2009)

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

Course nature				Theory and Lab			
Assessment Method (Weightage 100%)							
In-semester	Assessment tool	Mid Term I	Mid Term II	Assignments	CLA 1	CLA 2	Total
	Weightage Theory	15%	15%	5%	5%	10%	50%
End semester examination Weightage: 50%							50%

ENG 111	Basic Electronics	L	T	P	C
		3	0	0	3
Co-requisite:	NIL				
Prerequisite:	NIL				
Data Book / Codes/Standards	NIL				
Course Category	Engineering Sciences				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The course aims at introducing the Basic Electronic Device and Circuit concepts for all first year Engineering students. Students will get an understanding and appreciation of fundamental concepts, analyzing and designing simple Electronic Circuits for practical applications with devices such as Diodes, BJT, MOSFETs, etc.						
LEARNING OBJECTIVES						STUDENT OUTCOMES	
At the end of the course, student will be able to							
1.	Will get thorough understanding of fundamental concepts behind operation of basic Electronic devices and circuits in day to day applications.					a	e
2.	Analyze and design simple circuits with basic electronic devices.					a	
3.	Will have hands on analyzing and designing simple electronic circuits.					a	c
4.	Will have a project based learning through a course project as part of the evaluation and can learn to make a PCB.					c	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Basic Electronic Circuit Concepts	9			
1.	Introduction to Units, Scales, Charge, Current, Voltage, Power.	1	C	1	1
2.	Voltage and Current Sources, Dependent and Independent Sources.	1	C	1	1
3.	Ohm's Law, Resistance, Conductance, Resistivity, Conductivity.	1	C	1	1
4.	Introduction to Nodes, paths, Branches, Loop and KCL, Numerical.	1	C,D	1,2	1
5.	KVL, Single Loop and node pair circuits analysis.	1	C	1,2	1
6.	Series and Parallel connected sources, Resistors in series, parallel.	1	C	1	1
7.	Voltage and Current Division, Numerical.	1	C	1	1
8.	Thevenin Equivalent Circuits.	1	C	1	1
9.	Norton Equivalent Circuits.	1	C	1	1
	UNIT II – Semiconductor Basics and Diode Models	9			
10.	Introduction to Semiconductors- Si, Ge, GaAs, Covalent bonding and Intrinsic Semiconductors, Difference in band Diagrams of Insulators, conductors, Semiconductors.	1	C	1	2
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, 8 th Edition, Mc Graw Hill.
2.	“Electronic Devices and Circuit Theory” by R L Boylestad, L Nashelsky, 11 th edition.
3.	“Microelectronic Circuits Theory and Applications”, by Sedra and Smith, 7 th Edition, Oxford

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	CLA 1	CLA 2	Mid-I	Mid-II	Course Project	Total
	Weightage	10%	10%	15%	15%	15%	65%
End semester examination Weightage:							35%

PHY 112	Classical Mechanics	L	T	P	C
		2	0	2	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Basic Sciences				
<i>Course designed by</i>	Department of Physics				
<i>Approval</i>					

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

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

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

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

Course nature	Theory
Assessment Method (Weightage 100%)	

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

Sl. No	Experiment name	Objectives
1.	Determination of Young's modulus of the material	To calculate the Young's modulus of a given material by deflection method
2.	Determination of rigidity modulus of the material - torsional pendulum	To determine the rigidity modulus of the material of the wire by torsional oscillations
3.	Determine moment of inertia of a flywheel	To determine the moment of inertia of a flywheel
4.	Determination of spring constant	To determine spring constant for a given spring and verify the Hooke's law
5.	Damping Oscillation in Various Medium	To investigate the damping effect of air, water, oil or glycerine on an oscillating spring.
6.	Compound Pendulum	a. Measure the time period for a given compound pendulum with various lengths b. Determine radius of gyration of a given pendulum
7.	Particle size measurement	To determine particle size of a given powder
8.	Michelson's Interferometer	a) Determination of phase difference and wavelength using Michelson's interferometer b) Determination of Refractive index of glass plate using Michelson's interferometer
9.	Resolving Power of a Prism and verification of Cauchy's equation	Determine resolving power of a prism and verify Cauchy's equation using mercury light source

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%

CDC 111	Soft Skills-I	L	T	P	C
		1	0	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					

PURPOSE	The most conspicuous perceptual error is the thought that personality is confined to physical appearance alone. Personality is a complete package of an individual's identity; it is infact a person's reality. The development of one's personality is essential for having an impressive image both in the personal & professional areas to create an electrifying impact and a lasting impression.				
LEARNING OBJECTIVES			STUDENT OUTCOMES		
At the end of the course, student will be able to					
1.	Crack placement interviews and competitive exams.				

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – Know Thyself	3			
1.	Grooming & Social etiquette	1	C-I-O		1,2,3
	UNIT II - Personality Development	3			
2.	Personality construct, The KSAB Model	1	C-I-O		1,2,3
3.	Components of perception, perceptual errors	1	C-I-O		1,2,3
4.	perception as a precursor of attitude and behavior.	1	C-I-O		1,2,3
	UNIT III- Communication	3			
5.	The 3 Vs of communication: Visual or Kinesics, Vocal (Articulation), Verbal.	1	C-I-O		1,2,3
6.	Active listening, Barriers to listening.	1	C-I-O		1,2,3
7.	GARF (Giving and Receiving Feedback)	1	C-I-O		1,2,3
	UNIT IV – Presentation Skills	3			
8.	The four Ps of presentation.	1	C-I-O		1,2,3
9.	Handling different types of target audience.	2	C-I-O		1,2,3
	UNIT V- Time Management & Goal Setting	3			
10.	Pressure Cooker (Activity based on Planning, Organizing and Prioritization)	1	C-I-O		1,2,3

11.	Roller Coaster (Activity on setting SMARTER goals, planning & organizing, short & long term goals).	2	C-I-O		1,2,3
Total contact hours		15			

TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	The Perception of Deception, David Icke, David Icke Books, 2014
2.	Eye and Brain: The Psychology of Seeing, Richard, Langton Gregory, Princeton University Press, 1997
3.	Awaken The Giant Within, Anthony Robbins, Pocket Books, 2001

SEMESTER- II

EEE 101	Introduction of Electrical Engineering	L	T	P	C
		2	1	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical Engineering				
<i>Approval</i>					

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							
1.	Understand the fundamental laws and basic concepts of electrical circuits.						
2.	Gain knowledge on the analysis of electrical circuits using mesh current and node voltage methods.						
3.	To learn the fundamentals of magnetic and electrical circuits						
4.	Understand the steady-state analysis of RL, RC, and RLC circuits with phasor diagrams and three phase circuits.						
5.	To understand the working principle of electrical machines.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Circuit Analysis				
1.	Definition of charge, voltage, current, power, energy	1	C		1,2
2.	Ohm's law, Kirchhoff's laws, Concept of Node, Path, Loop, Branch in a circuit	1	C		1,2
3.	Resistors in Series and Parallel, Voltage and Current Division, Ideal and Practical Voltage and Current Source	1	C		1,2
4.	Source Transformations, Nodal Analysis, Mesh Analysis, Super node, Super mesh	1	C		1,2
5.	Independent and Dependent Voltage and Current Sources	1	C		1,2
6.	Network Reduction technique using Star – Delta Transformation. Illustrative examples	1	C		1,2
	UNIT-II Network Theorems and Two Port Networks				
7.	Superposition Theorem, Thevinin's Theorem, Norton's Theorem	1			
8.	Maximum Power Transfer Theorem, Reciprocity Theorem	1			
9.	Milliman's Theorems--with Independent and Dependent Voltage and Current Sources. Illustrative examples	2			

10.	One Port Networks, Admittance Parameters, Impedance Parameters, Hybrid Parameters and Transmission Parameters. Illustrative examples.	2			
UNIT- III Circuit Dynamics and Forced Response					
11.	Step Response of a Series RL, RC (First Order System) and RLC Circuit (Second Order System)	1			
12.	under DC Source Excitation--Time Constant, Rise Time, Peak Time	1			
13.	Peak Overshoot/Undershoot and Settling Time. Principle of Duality. Illustrative examples	1			
UNIT-IV Single-phase AC circuits					
14.	Basic Concepts Related to Generation of Sinusoidal AC Voltage, Definitions of Average Value	1	C		1-3
15.	Root Mean Square Value, Form Factor and Peak Factor	1	C		1-3
16.	Steady State Analysis of Pure R, L, C Circuits, RL, RC and RLC circuits with Phasor Diagrams under AC Excitation	2	C		1-3
17.	Concepts of Resonance, Definitions of Real Power, Reactive Power, Apparent Power and Power Factor. Illustrative examples.	2	C		1-3
UNIT – V Three Phase Circuits					
18.	Necessity and Advantages of Three Phase Power Systems, Generation of Three Phase Power	1	C		1-3
19.	Definition of Phase Sequence, Balanced Supply and Balanced Load	1	C		1-3
20.	Relationship Between Line and Phase Values of Balanced Star and Delta Connections	1	C		1-3
21.	Power in Balanced Three-Phase Circuits, Measurement of Three Phase Power by Two-Wattmeter Method. Illustrative examples	2	C, D		1-3
Total contact hours					

LEARNING RESOURCES

TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1.	Electrical Engineering Fundamentals, Vincent Del Toro, Second Edition, PHI
2.	Fundamentals of Electrical Engineering, Second edition, Leonard S. Bobrow, Oxford University press, 2011
3.	Introduction to Electric Circuits, Richard C. Dorf and James A. Svoboda, Wiley India Private Limited, Sixth Edition, 2007
4.	A Textbook of Electrical Technology, B.L. Theraja and A.K Theraja, S.Chand and Co. Ltd., 2000.
5.	Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N.O. Sadiku, McGraw Hill Higher Education, Third Edition, 2005
6.	Introductory Circuit Analysis, Robert L. Boylestad, Twelfth edition, Pearson, 2012.

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%

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	Verification of Ohm's Law	2			1&2
2.	Verification of Kirchoff's Voltage Law	2			1&2
3.	Verification of Kirchoff's Current Law	2			1&2
4.	Verification of Thevenin's Theorem	2			1&2
5.	Verification of Norton's Theorems	2			1&2
6.	Verification of Superposition theorem	2			3&4
7.	Verification of Maximum Power Transfer Theorem	1			3&4
8.	Verification of Reciprocity Theorems	1			3&4
9.	I-V Characteristics of Tungsten filament bulb	1			3&4
Total contact hours		15			

LEARNING RESOURCES

TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Electrical Engineering Fundamentals, Vincent Del Toro, Second Edition, PHI
2.	Fundamentals of Electrical Engineering, Second edition, Leonard S. Bobrow, Oxford University press, 2011
3.	Introduction to Electric Circuits, Richard C. Dorf and James A. Svoboda, Wiley India Private Limited, Sixth Edition, 2007
4.	A Textbook of Electrical Technology, B.L. Theraja and A.K Theraja, S.Chand and Co. Ltd., 2000.
5.	Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N.O. Sadiku, McGraw Hill Higher Education, Third Edition, 2005
6.	Introductory Circuit Analysis, Robert L. Boylestad, Twelfth edition, Pearson, 2012.

CSE 223	Data Structures and Algorithms Using C	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Engineering Sciences				
<i>Course designed by</i>	Department of Computer Science Engineering				
<i>Approval</i>					

PURPOSE	The course aims to provide ability to understanding basic data structures and algorithms. Provide independent view of data structures, including its representation and operations performed on them, which are then linked to sorting, searching and indexing methods to increase the knowledge of usage of data structures in algorithmic perspective. Provide ability to analyze the computational complexity of the programs.						
LEARNING OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to							
1.	To learn basics of programming knowledge in C.						
2.	The course is designed to get the knowledge of define basic static and dynamic data structures and relevant standard algorithms.						
3.	Select basic data structures and algorithms for autonomous realization of simple programs or program parts.						
4.	Determine and demonstrate bugs in program, recognize needed basic operations with data structures.						
5.	Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures, evaluate algorithms and data structures in terms of time and memory complexity of basic operations.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to C programming	12			
1.	Basic elements of C: Identifiers, basic data types, constants, variables, keywords.	1			1
2.	Operators: arithmetic, relational and logical, increment and decrement operators, conditional operators, assignment operators.	1			
3.	Instruction: type declaration, Input-output, conditional, loop control.	1			1
4.	Derived types: Arrays.	1			
5.	Functions.	1			1
6.	Pointers.	1			1
7.	Dynamic memory management functions.	1			1
8.	Structures: Declaration, definition and initialization of structures,	1			1

	accessing member of structure.				
9.	Arrays of structures, structures and functions, pointers to structures, self-referential structures.	1			1
	Unit II : Introduction to Data structures	9			
10.	Stacks: representation and application, implementation of stack operations using C.	1			1
11.	Queues: representation and application, implementation of queue operations using C.	1			1,2
12.	Example applications on Stacks and Queues.	1			1,2
13.	Linked lists: Single linked lists representation.	1			1,2
14.	Implementation of linked list various operation using C.	1			1
15.	Double linked list representation.	1			1,2
16.	Implementation of double linked list various operation using C.	1			
17.	Circular list.	1			
18.	Implementation of Circular linked list various operation using C.	1			
	UNIT III – Trees:	9			
19.	Tree terminology.	1			1
20.	Binary tree.	1			1
21.	Binary search tree.	1			1
22.	Infix to Post fix conversion.	1			1
23.	Postfix expression evaluation.	1			1
24.	General tree.	1			
25.	AVL Tree.	1			1
26.	Complete Binary Tree representation.	1			
27.	Complete Binary Tree implementation using C.	1			
	UNIT IV: Graphs	9			
28.	Graph terminology, Representation of graphs.	1			4
29.	Path matrix.	1			4
30.	BFS (breadth first search)	1			4
31.	Implementation of BFS using C.	1			4
32.	DFS (depth first search)	1			4

33.	Implementation of DFS using C.	1			
34.	Topological sorting.	1			
35.	Shortest path algorithms.	1			
36.	Implementation of shortest path algorithm using C.	1			
	UNIT V: Sorting and Searching techniques	9			
37.	Bubble sort and its algorithm analysis.	1			2
38.	Selection sort and its algorithm analysis.	1			2,4
39.	Insertion sort and its algorithm analysis.	1			2
40.	Quick sort and its algorithm analysis.	1			2,4
41.	Merge sort and its algorithm analysis.	1			
42.	Heap sort and its algorithm analysis.	1			
43.	Radix sort and its algorithm analysis.	1			
44.	Linear and binary search methods and its algorithm analysis.	1			
45.	Hashing techniques and hash functions.	1			
	Total contact hours	60			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	“Data structure using C”, Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
2.	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.
3.	Programming with C , Byron Gottfried, Mcgrawhill Education, Fourteenth reprint, 2016
4.	“ Fundamentals of data structure in C ” Horowitz, Sahani & Anderson Freed, Computer Science Press.
5.	“ Fundamental of Data Structures ” , (Schaums Series) Tata-McGraw-Hill.
6.	G.A.V.Pai:“ Data Structures & Algorithms; Concepts, Techniques & Algorithm ” Tata McGraw Hill.

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	Write a C program to find the factorial of the given number (Example: $5! = 5*4*3*2*1 = 120$)	1	C, I, O		1,2
2.	Write a C program to read the numbers from the keyboard using a loop, perform the sum and average of	1	C, I, O		1,2

	all the input numbers until “-10” is encountered.				
3.	Write a C program for implementation of Stack operations using arrays.	1	C, I, O		1,2
4.	Write a C program for implementation of Queue operations using arrays.	1	C, I, O		1,2
5.	Write a C program for Linked list implementations and problems related to linked list such as inverting list, concatenation, etc	1	C, I, O		1,2
6.	Write a C program for Linked list-based implementation of stack and queue operations.	1	C, I, O		1,2
7.	Write a C program for Evaluation of expressions.	1	C, I, O		1,2
8.	Write a C program for implementation of Binary tree traversals techniques.	1	C, I, O		1,2
9.	Write a C program for implementation of Graph traversals techniques (BFS and DFS)	1	C, I, O		1,2
10.	Write a C program for Linear search and Binary search algorithms. What is the best case and worst-case time complexity of those searching algorithms?	1	C, I, O		1,2
11.	Write a C program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm?	1	C, I, O		1,2
12.	Write a C program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?	1	C, I, O		1,2
13.	Write a C program for Insertion sort algorithm. What is the worst case or average case time complexity of Insertion sort algorithm?	1	C, I, O		1,2
14.	Write a C program for Quick sort algorithm. What is the worst case or average case time complexity of Quick sort algorithm?	1	C, I, O		1,2
15.	Write a C program for Merge sort algorithm. What is the worst case or average case time complexity of Merge sort algorithm?	1	C, I, O		1,2
	Total contact hours	15			

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	“Data structure using C”, Aaron M. Tenenbaum, Y Langsam and Mosche J. Augenstein, Pearson publication.
2.	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.
3.	Programming with C , Byron Gottfried, Mcgrawhill Education, Fourteenth reprint,2016
4.	“Fundamentals of data structure in C” Horowitz, Sahani & Anderson Freed, Computer Science Press.
5.	“Fundamental of Data Structures” , (Schaums Series) Tata-McGraw-Hill.
6.	G.A.V.Pai:“Data Structures & Algorithms; Concepts, Techniques & Algorithm” Tata McGraw Hill.

Course nature				Theory and Lab			
Assessment Method (Weightage 100%)							
In-semester	Assessment tool	Mid Term 1	Mid Term II	Assignments	CLA 2	CLA 1	Total
	Weightage Theory	15%	15%	5%	10%	5%	50%
End semester examination Weightage:							50%

CHE 101	Principles of Chemistry			L	T	P	C
				2	0	2	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book/ Codes/Standards	NIL						
Course Category		Foundation Course		Basic Science			
Course designed by	Department of Chemistry						
Approval	-- Board of Studies -- , 2018						

PURPOSE	The course aims to provide a basic understanding of various states of matter (gas, liquid, and solids) and the chemical bonding within. Also, this course helps the students to understand various fundamental concepts when they are dealing respective core engineering subjects. Along the way, students learning focus on sustainability, where priority is given to environmentally friendly materials.						
LEARNING OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to							
1.	Distinguish the types of bonding and also predict the structure, electronic and magnetic properties of molecules.						
2.	Classify the types of chemical reactions based on reaction energetics and kinetics. Also, interprets stability of materials based on the temperature, pressure and concentration variables.						
3.	Gain in-depth knowledge on crystalline materials and their applications in electronic devices.						
4.	Identify the types of polymers and familiar with industrial applications of common synthetic and biodegradable polymers.						
5.	Know the storage mechanism of various electrochemical cells and their applications namely electronic and e-mobility.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Chemical Bonding	9			
1.	Introduction to basics such as ionization potential, electron affinity, and electronegativity.	1	C		1
2.	Ionic, covalent, and metallic bonding with examples and properties of Ionic, covalent, and metallic compounds.	1	C		1
3.	Hydrogen bonding, classifications with examples.	1	C		1
4.	Nature of covalent bonds such as sigma and pi bonds.	1	C		1
5.	VESPER Theory: Hybridization with examples - I	1	C,D		1
6.	VESPER Theory: Hybridization with examples - II	1	C,D		1
7.	Introduction to Molecular Orbital theory.	1	C		1

8.	Molecular Orbital theory with examples.	1	C,D		1
9.	Molecular Orbital theory : bond order and magnetic properties.	1	C,D		1
	UNIT II – Phase Rule, Thermochemistry, and Kinetics	6			
10.	Definition of the terms used in phase rule with examples.	1	C		1
11.	Application of phase rule to one component system (eg Water)	1	C,D		1,2
12.	Application of phase rule to two component system (eg Pb-Sn)	1	C,D		1,2
13.	Standard terms in thermochemistry and their significance.	1	C		1,2
14.	Heat of combustion, formation and sublimation (with examples in fuels and propellants)	1	C,D		1
15.	Order and molecularity of reactions, zero order, first order rate equations, and problems associated with Zero & First order.	1	C		1,2
	UNIT III – Crystalline Materials	6			
16.	Introduction to solid state materials, difference between crystalline and amorphous systems, properties of crystalline materials.	1	C		1
17.	Crystal lattice, unit cells, types of crystal systems, types of unit cells (Bravais lattices)	1	C		1
18.	Miller indices, Bragg's law, problems associated theoretical density of crystals and Bragg's equation.	1	C		1
19.	Introduction to Band theory, metals, insulators, and semiconductors with examples.	1	C,D		1
20.	Classification of semiconductors, imperfections in crystals.	1	C,D		1
21.	Frenkel and Schottky defects, doping and devices.	1	C		1
	UNIT IV: Materials Chemistry	5			
22.	Introduction to Polymers, Classification of polymers.	1	C		4
23.	Thermoplastic and Thermosetting polymers with examples, Tacticity of polymers.	1	C		4
24.	Properties of polymers: Tg, Molecular weight, weight average, Problems associated with Molecular weight, weight average.	1	C,D		4
25.	Degradation of polymers and biodegradable polymers, Common Polymers: Elastomer, Conducting polymer.	1	C,D		4
26.	Hardness in water, demineralization of water and Zeolite process.	1	C,D,I		4
	UNIT V: Electrochemical Devices	4			

27.	Introduction to Electrochemical cells and classification of Electrochemical cells.	1	C		2
28.	Primary and secondary cells with examples.	1	C, D		2,4
29.	Lead-acid battery and Li ⁺ batteries.	1	C		2
30.	Li ⁺ batteries and Fuel cells.	1	C,D		2,4
Total contact hours		30			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	A.Bahl, B.S. Bahl, G.D. Tuli, <i>Essentials of Physical Chemistry</i> , (2016), S Chand Publishing Company.
2.	B. R. Puri, L. R. Sharma & M. S. Pathania, <i>Principles of Physical Chemistry</i> , 46 th Edition (2013), Vishal Publication Company.
3.	D. F. Shriver, P. W. Atkins and C. H. Langford, <i>Inorganic Chemistry</i> , 3 rd Ed., Oxford University Press, London, 2001.
4.	V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, <i>Polymer Science</i> , New Age International, 1986. ISBN: 0-85226-307-4.
5.	Atkins, P.W.; de Paula, J. (2006). <i>Physical chemistry</i> (8 th ed.). Oxford University Press. ISBN 0-19-870072-5.

Course nature					Theory			
Assessment Method (Weightage 70%)								
In-semester	Assessment tool	Midterm I	Midterm II	Assignment	Class Test	Quiz	Total	Final
	Weightage	15%	15%	10%	5%	5%	50%	35%
End semester examination Weightage:								35%

Session	Description of Topic	Contact hours
1.	Volumetric titration of HCl vs NaOH.	1
2.	Conductometric titration of HCl vs NaOH	2
3.	Standardization of potassium permanganate by Oxalic acid.	2
4.	Iodometric Determination of Ascorbic Acid (Vitamin C)	2
5.	Determination of hardness of water by EDTA method	2

6.	Determination of strength of given hydrochloric acid using pH meter	2
7.	Determination of sodium and potassium by flame photometry	2
8.	Determination of sodium and potassium by flame photometry.	2
	Total Hours	15

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	G.H Jeffery, J Bassett, J Mendham, R.C Denny, <i>Vogel's Textbook of Quantitative Chemical Analysis</i> , Longmann Scientific and Technical, John Wiley, New York.
2.	J.B Yadav, <i>Advanced Practical Physical Chemistry</i> , Goel Publishing House, 2001 .
3.	A.I Vogel, A.R Tatchell, B.S Furnis, A.J Hannaford, P.W.G Smith, <i>Vogel's Textbook of Practical Organic Chemistry</i> , Longman and Scientific Technical, New York, 1989 .
4.	J.V. McCullagh, K.A. Daggett, <i>J. Chem. Ed.</i> 2007 , <i>84</i> , 1799.

Course nature			Practical			
Assessment Method (Weightage 30%)						
In-semester	Assessment tool	Lab performance	Model exam	Observation note	Total	Final
	Weightage	20%	20%	10%	50%	15%
End semester examination Weightage:						15%

PHY 221	Electricity and Magnetism	L	T	P	C
		2	0	2	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Basic Sciences				
<i>Course designed by</i>	Department of Physics				
<i>Approval</i>					

PURPOSE	The purpose of this course is to introduce students about the basics of electricity and magnetism as well as their dynamics. We also introduce the analytical methods for solving field problems and explanation of all four Maxwell's equations.													
LEARNING OBJECTIVES								STUDENT OUTCOMES						
At the end of the course, student will be able to														
a)	To provide a comprehensive background of field and potentials for electrostatics and magneto-statics.													
b)	To provide a comprehensive background of electrodynamics and Maxwell's equations.													
c)	To discuss the various analytical techniques for finding electric and magnetic fields.													
d)	To experience the hands-on experience of the practical to help the students for real time understanding of the physical process.													

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I –Introduction to Vector Algebra	6			
1.	Introduction to vectors, scalar and vector product.	1	C		1,2
2.	Gradient of a scalar field.	1	C,O		1,2
3.	Divergence and Curl of vector fields and their physical significance.	1	C,O		1,2
4.	Gauss and Stokes theorems.	1	C		1,2
5.	Coordinate systems–introduction to Cartesian system.	1	C		1,2
6.	Spherical and Cylindrical coordinate systems.	1	C		1,2
	UNIT II – Electrostatics	6			
7.	Coulomb's law and electric field.	1	C		1,2
8.	Gauss Law.	1	C,D		1,2
9.	Electric Potential.	1	C		1,2
10.	Potential Energy.	1	C		1,2

11.	Conductors under Electrostatic Equilibrium.	1	C		1,2
12.	Capacitors.	1	C		1,2
	UNIT III –Dielectrics and Polarization	6			
13.	Introduction to Electric Dipole and dipole Moment.	1	C		1,2
14.	Potential and field due to electric dipole.	1	C		1,2
15.	Polarization in dielectrics.	1	C		1,2
16.	Modification of Gauss’s Law in terms of electric displacement.	1	C,D		1,2
17.	Electric Susceptibility and dielectric constant.	1	C,D		1,2
18.	Bound charges.	1	C		1,2
	UNIT IV: Magneto statics	6			
19.	Magnetic force and cyclotron.	1	C		1,2
20.	Biot-Savart Law for magnetic fields.	1	C,D		1,2
21.	Magnetic field due to various current loops.	1	C		1,2
22.	Ampere’s circuital law.	1	C		1,2
23.	Equation of Continuity.	1	C		1,2
24.	Magnetization in Materials.	1	C		1,2
	UNIT V: Introduction to Electrodynamics	6			
25.	Introduction to time-varying fields.	1	C		1,2
26.	Faraday’s law of induction.	1	C		1,2
27.	Generalization of Ampere’s law.	1	C		1,2
28.	Maxwell’s equations.	1	C		1,2
29.	Derivation of wave equation.	1	C		1,2
30.	Planar Waves in free space.	1	C		1,2
	Total contact hours		30		

The list of experiments for practical session:

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	To find the dielectric constant of the medium using parallel plate capacitor.	1	C, I, O		1,2

2.	To find the band gap energy of a semi-conductor using Four-probe method.	1	C, I, O		1,2
3.	To find the band gap energy of a semi-conductor using Four-probe method.	1	C, I, O		1,2
4.	Find the magnetic field due to Helmholtz coils and verify its relation by varying the distance.	1	C, I, O		1,2
5.	Use Faraday's law for finding the total magnetic flux through the coil.	1	C, I, O		1,2
6.	To find the type and concentration of charge carriers using hall probe.	1	C, I, O		1,2
7.	Verify the Biot-Savart law for a given circular coil.	1	C, I, O		1,2
8.	To find the fill factor of a given solar cell using I-V characteristics.	1	C, I, O		1,2
9.	To find the type of material using the deflection in magnetic field.	1	C, I, O		1,2
10.	To study the Hysteresis curve for a given magnetic material.	1	C, I, O		1,2
11.	Practice session I and remedial session.	1	C, I, O		1,2
12.	Practice session II and remedial session.	1	C, I, O		1,2
13.	Model Exam.	1	C, I, O		1,2
14.	Model Exam.	1	C, I, O		1,2
15.	Model Exam.	1	C, I, O		1,2
Total contact hours		15			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Introduction to Electrodynamics –David J. Griffiths; 4 th Edition, 2012, PHI Eastern Economy Editions
2.	Electricity and Magnetism- A. S. Mahajan and A. A. Rangwala, 1 st Revised Edition, 2007, McGraw-Hill Education

Course nature		Theory + Practical				
Assessment Method theory (Weightage 60%)						
In-semester	Assessment tool	Mid term Exam I	Mid-term Exam II	Assignment	Class Test and quiz	Total
	Weightage	15%	15%	10%	10%	50%
End semester examination Weightage:						50%
Assessment Method practical (Weightage 40%)						

In-semester	Assessment tool	Model lab exam	Lab performance	Observation book	Total
		Weightage	20%	20%	10%
End semester examination Weightage:					50%

ECO 121	Principles of Economics			L	T	P	C
				3	0	0	3
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	NIL						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>			PRINCIPLES OF ECONOMICS				
<i>Course designed by</i>	Department of Economics						
<i>Approval</i>							

PURPOSE	This course will provide you with a basic understanding of the principles of microeconomics. 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.						
LEARNING OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to							
1.	Analyse relevant economic concepts and economic models which inform the study of microeconomics.	D					
2.	Apply the principles of microeconomics associated with supply and demand in determining market equilibrium and the effects of price controls and elasticity.	D	I	J	A		
3.	Apply the principles of microeconomics 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		
4.	Analyze market structures and apply theoretical concepts of perfect competition to identify the behavior of monopolies and imperfect competition.	D	I	A	J		
5.	Analyze resource markets to understand the decision-making of resource allocation and interrelationships among key markets in the economy	D	I	A	J		

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: INTRODUCTION TO ECONOMICS	5			
1.	Why study economics? Scope and method of economics; the economic problem: scarcity and choice; the question of what to produce, how to produce and how to distribute output	1	C		1
2.	science of economics; the basic competitive model; prices,	1	C		1,2
3.	science of economics; the basic competitive model; prices,	1	C		2
4.	property rights and profits; incentives and information; rationing;	1	C	1	1
5.	opportunity sets; economic systems; reading and working with graphs	1	C-D-I		
	UNIT II – DEMAND AND SUPPLY	8			
6.	Determinants of individual demand/supply; demand/supply schedule and demand/supply curve; market versus individual demand/supply.	1	C		1
7.	Shifts in the demand/supply curve, demand and supply together.	1	C		1
8.	How prices allocate resources; elasticity and its application.	1	C		1
9.	How prices allocate resources; elasticity and its application.	1	C-I	2,3	1
10.	Controls on prices; taxes and the costs of taxation.	1	C	1,2	1
11.	Controls on prices; taxes and the costs of taxation.	1	C	2	1
12.	Consumer surplus; producer surplus and the efficiency of the markets.	1	C	2	1
13.	Consumer surplus; producer surplus and the efficiency of the markets.	1	C	2	1

	UNIT III- CONSUMER THEORY	10			
14.	The consumption decision - budget constraint.	1	C	3	2
15.	The consumption decision - budget constraint, consumption and income/price changes.	1	C	3	2
16.	Demand for all other goods and price changes.	1	C	3	2
17.	Utility and preferences (indifference curves); properties of indifference curves.	1	C	3	2
18.	Utility and preferences (indifference curves); properties of indifference curves.	1	C	3	2
19.	Consumer 's optimum choice.	1	C	3	2
20.	In come and substitution effects.	1	C	3	2
21.	Income and substitution effects.	1	C	3	2
22.	Applying consumer theory: Labor.	1	C-I	3	2
23.	Applying consumer theory: Labor.	1	C-I		
	UNIT IV: PRODUCER THEORY	12			
24.	Production, short- run production function and returns to factor.	1	C	2	2
25.	Production, short- run production function and returns to factor.	1	C	2	2
26.	Production, short- run production function and returns to factor.	1	C		
27.	Average-marginal relationship.	1	C	3	1
28.	Long– run production function and laws of return to scale- role of technology.	1	C	3	1
29.	Long– run production function and laws of return to scale- role of technology.	1	C	3	1
30.	Long– run production function and laws of return to scale- role of technology.	1	C		
31.	Cost function and cost structure of a firm in the short- run.	1	C	3	2
32.	Cost function and cost structure of a firm in the short- run.	1	C	3	2
33.	Long run cost function and cost structure.	1	C		
	UNIT V: TYPES OF MARKET	10			

34.	Perfect competition- profit maximization.	1	C	4	1
35.	Shut-down and break-even points.	1	C	4	1
36.	Monopoly: marginal revenue; marginal cost; profit maximization.	1	C	4	2
37.	Monopoly: marginal revenue; marginal cost; profit maximization.	1	C	4	2
38.	Shutdown rule; market power; price discrimination.	1	C	4	2
39.	Monopolistic competition and product differentiation.	1	C	4	2
Total contact hours		45			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1	Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition.
2	Perloff, Jeffrey M. <i>Microeconomics</i> . 5th ed. Addison Wesley, 2008. ISBN: 9780321558497.

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%	

MAT 121	Multi 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	This is a fundamental course Student able to learn how to find double integral, triple integral& surface integral.					
LEARNING OBJECTIVES	STUDENT OUTCOMES					
At the end of the course, student will be able to						
1.	An understanding of a parametric curve as a trajectory described by a position vector; the ability to find parametric equations of a curve and to compute its velocity and acceleration vectors.					
2.	A comprehensive understanding of the gradient, including its relationship to level curves (or surfaces), directional derivatives, and linear approximation.					
3.	The ability to compute derivatives using the chain rule or total differentials.					
4.	In understanding of line integrals for work and flux, surface integrals for flux, general surface integrals and volume integrals. Also, an understanding of the physical interpretation of these integrals.					
5.	The ability to set up and compute multiple integrals in rectangular, polar, cylindrical and spherical coordinates.					
6.	An understanding of the major theorems (Green's, Stokes', Gauss') of the course and of some physical applications of these theorems.					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I VECTORS AND MATRICES	9			
1.	Three-dimensional coordinate system.	2	C		1
2.	Vectors.	2	C		1
3.	Dot products.	2	C		1
4.	Vector products.	2	C		1
5.	Lines and planes.	1	C		1
	UNIT-II PARTIAL DERIVATIVES	9			

6.	Functions of several variables.	2	C		1
7.	Limits and continuity for several variable functions.	2	C		1
8.	Partial derivatives.	2	C		1
9.	The chain rule	1	C		1
10.	Directional derivatives.	1	C		1
11.	Gradient.	1	C		1
	UNIT- III DOUBLE INTEGRAL AND LINE, INTEGRAL IN PLANES	9	C		1
12.	Extreme values.	3	C		1
13.	Saddle points.	3	C		1
14.	Lagrange multipliers.	3	C		1
	UNIT-IV TRIPLE INTEGRALS IN 3D	9			
15.	Double and integrated integrals.	5	C		1
16.	Area by double integration.	4	C		1
17.	UNIT – V SURFACE INTEGRALS IN 3D	9	C		1
18.	Triple integration and applications	9	C		1
	Total contact hours	45			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Edwards, Henry C., and David E. Penney. Multivariable Calculus. 6th ed. Lebanon, IN: Prentice Hall, 2002
2.	G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.
3.	T. M. Aposol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

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%
End semester examination Weightage:						50%

CDC 102	SOFT SKILLS II	L	T	P	C
		1	0	0	1
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Skill Building				
<i>Course designed by</i>	Department of Career Development				
<i>Approval</i>					

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 Positive attitude and Self-Motivated attitude.					
2.	Develop Lateral thinking skills and understand its importance.					
3.	To work in a Team dynamic.					

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: MOTIVATION	3			
1.	Maslow's theory of Motivation.	1	C	1, 3, 4	1
2.	Soldiers' Walk and The Japanese Fan (Activities on factors of motivation)	1	D	1, 4	
3.	Steps to ward off de-motivation.	1	I	1, 4	1
	UNIT II – CREATIVITY AND INNOVATION	4			
4.	Activity on Brain Storming, Types of Creativity, Common Barriers of creativity.	1	D	1	1, 2
5.	Sources of New Idea.	1	I	1, 4	2
6.	Activity topics to enhance the power of aesthetics and precision. Aim is to create interest in research.	1	O	1, 2, 4	
7.	Activity.	1	O		
	UNIT III – CRITICAL AND LATERAL THINKING	3			
8.	Importance's of Critical and Lateral thinking.	1	I	1	2, 3

9.	Fill Me Up, Stimulating Lateral Thinking.	1	I	1, 4	2, 3
10.	Activity to enhance critical and lateral thinking.	1	I, O	1, 2, 4	2, 3
	UNIT IV: TEAM DYNAMICS	4			
11.	Importance of Team Dynamics.	1	C	1, 2, 3, 4	3
12.	Story boarding, Frenzy.	1	C	1, 2	-
13.	Activities Come to my Island, Striking Cars, Defend the Egg, Tallest Tower.	1	O	1, 2, 3	-
14.	Activities on the different stages of team building, team communication, coordination and collaboration.	1	O	1, 2, 3, 4	-
	UNIT V: MINI PROJECT	1			
15.	Individual projects on topics provided by faculties.	1	O	1, 2, 3, 4	-
	Total contact hours	15			

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

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Maslow, A. H. (1943) A Theory of Human motivation. In R. J. Lowry (1973) Dominance, Self-Esteem, Self-Actualization: Germinal Papers of A.H. Maslow (pp. 153-173). Belmont, California: Wadsworth Publishing Company, Inc.
2.	Sparking Student Creativity, Practical ways to promote innovative and problem solving, Patti Drapeau.
3.	Teach yourself to think, Edward de Bono, 1995

ASSESSMENT

1. A practical and activity-oriented course which has continuous assessment for 75 marks based on classroom interaction, activities etc.
2. Mini Project – 25 marks.

Course nature					Theory	
Assessment Method (Weightage 100%)						
In-semester	Assessment tool	Activity II	Activity III	Activity IV	Mini Project	Total
	Weightage	20%	20%	20%	40%	100%
End semester examination Weightage:						0%

SEMESTER III

EE 201	ELECTRICAL AND ELECTRONICS MEASUREMENT	L	T	P	C
		2	1	0	3
<i>Co-requisite:</i>					
<i>Prerequisite:</i>	Engineering Physics (PHY 101), Introduction to Electrical Engineering (EE 101), Multivariable Calculus (MAT 121)				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical Engineering				
<i>Approval</i>					

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							
1.	Recognize the evolution and history of units and standards in Measurements.						
2.	Identify the various parameters that are measurable in electronic instrumentation.						
3.	Employ appropriate instruments to measure given sets of parameters.						
4.	Practice the construction of testing and measuring set up for electronic systems and relate the usage of instrumentation standards.						
5.	To have a deep understanding about instrumentation concepts which can be applied to control systems.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Fundamentals of Measuring Instruments	9			
1.	Instrumentation and Measurements	1	C, D		1
2.	Measuring Instruments and classifications	1	C		1
3.	Static and Dynamic Characteristics of Measurement System	1	C		1, 2
4.	Error in Measurements	1	C, D		1
5.	Principle of operation - Permanent Magnet Moving Coil (PMMC) Instrument	1	C, D		1, 2
6.	Constructional Details of moving coil instrument	1	C		1, 2

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

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

LEARNING RESOURCES	
	TEXT BOOKS^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
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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%

EE 202	Electrical Circuit Analysis	L	T	P	C
		2	1	0	3
<i>Co-requisite:</i>	Differential Equations (MAT131)				
<i>Prerequisite:</i>	Introduction to Electrical Engineering (EE 101)				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

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 the basic concepts and behavior of different electrical circuits.							
b) Apply the techniques of circuit analysis to solution of two -port electrical network problems.							
c) Get an insight into the solution of complex DC and AC circuits using network theorems.							
d) Understand the transient behavior of RL, RC, and RLC circuits under dc and ac excitation.							
e) 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, “ <i>Engineering Circuit Analysis</i> ”, McGraw Hill, 8 th Edition, 2011.
2 ^a	Sudhakar. A and Shyam Mohan.S. P, “ <i>Circuits and Networks Analysis and Synthesis</i> ”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
3 ^a	Richard C.Dorf and James A.Svobada “ <i>Introduction to Electric Circuits</i> ”, Wiley India Private Limited ,Sixth Edition ,2007
4 ^b	Charles K. Alexander and Matthew N.O. Sadiku, “ <i>Fundamentals of Electric Circuits</i> ” McGraw Hill Higher Education, Third Edition, 2005.

5 ^b	Abhijit Chakrabarti, “ <i>Circuit Theory Analysis and Synthesis</i> ” Dhanpat Rai & Co. 7 th Edition, 2017.
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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%

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

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.
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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", 5 th 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%

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", 5 th 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	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Open Electives				
<i>Course designed by</i>	Department of Electronics and Communication Engineering				
<i>Approval</i>					

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.
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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 TRANSFORM	7			
25.	Introduction to Laplace transform and region of convergence.	2	I,O		1,2
26.	Properties of Laplace transform.	2	I,O		1,2
27.	Inverse Laplace transform.	1	I,O		1,2
28.	Initial and final value theorems.	2	I,O		1,2
	UNIT IV: Z TRANSFORM	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, 2 nd edition. ISBN: 9780138147570.
2.	“Signals and Systems” by Simon Haykin and Berry van Veen, 2 nd edition, ISBN: 9780471164746.
3.	“Principles of Signal Processing and Linear Systems” by B P Lathi, 2 nd 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%

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, 2 nd 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%

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

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	2	C		1

	Oscillations, Electric Circuits)				
	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, <i>Elementary Differential Equations and Boundary Value Problems</i> , 11 th Edition, Wiley-India.
2.	Erwin Kreyszig, <i>Advanced Engineering Mathematics</i> , 10 th Edition, Wiley-India.
3.	Mary L. Boas, <i>Mathematical Methods in Physical Sciences</i> , 3rd Edition, Wiley-India.
4.	G. F. Simmons, <i>Differential Equation with Applications and Historical Notes</i> , TATA McGraw Hill

5.	S. Vaidyanathan, <i>Advanced Applicable Engineering Mathematics</i> , CBS Publishers
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Course nature				Theory			
Assessment Method (Weightage 100%)							
In- semester	Assessment tool	Mid Term I	Mid Term II	CLA 1	CLA 2	Project	Total
	Weightage	15%	15%	5%	10%	5%	50%
	End semester examination Weightage: 50%						50%

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

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

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I – THERMODYNAMICS	10			1,2
1.	Sources of Energy, Types of Prime Movers. Basic concepts, Microscopic and macroscopic approach. Thermodynamic system and surrounding.	1			1,2
2.	Properties of a system, Intensive and extensive, Specific and total quantities, Path and point functions.	1			1,2
3.	Thermodynamic process, cycle and equilibrium, Quasi-static, Reversible and Irreversible processes.	1			1,2
4.	Heat and work transfer, displacement work, flow work and other modes of work, p-V diagram.	2			1,2
5.	Zeroth law of thermodynamics, concept of temperature.	2			1,2
6.	First law of thermodynamics, energy, enthalpy, specific heats, limitations of first law, cyclic heat engine, energy reservoirs. Applications of first law.	2			1,2

7.	Statements of second law and their equivalence. Reversibility, Irreversibility and Causes of irreversibility. Carnot cycle, Carnot theorem, Clausius theorem, Concept of entropy.	1			1,2
	UNIT II – HEAT ENGINES	10			1,2
8.	Classification of energy sources, Introduction to fuels and combustion, Classification of fuels, calorific value, Global warming	2			1,2
9.	Thermal prime movers, elementary heat engines, working substances, classification of heat engines.	2			1,2
10.	Heat engine cycles – Carnot cycle and its efficiency.	1			1,2
11.	Properties of water, ideal Rankine cycle (vapor power cycle), methods to improve Rankine cycle efficiency.	1			1,2
12.	Air standard cycles, Piston cylinder geometry and arrangement, Ideal Otto cycle.	2			1,2
13.	Ideal Diesel cycle, differences between petrol and diesel engines.	1			1,2
14.	2 stroke engines, differences between 2 stroke and 4 stroke engines, IC Engine components.	1			1,2
	UNIT III – FLUID MECHANICS	3			3
15.	Introduction, Physical Properties of Fluids, Relationship Between Stress and Strain-Rate for Newtonian and Non-Newtonian Fluids.	1			3
16.	Description of Fluid Flow, Classification of Flows- Laminar and Turbulent Flows, Measurement of viscosity.	2			3
	UNIT IV: MECHANICAL ENGINEERING EQUIPMENT	4			1,2
17.	Pump basics – Classification, Centrifugal, Positive displacement, Reciprocating; Compressor basics - Air compressors, compressor cycle, centrifugal, axial compressor.	1			1,2
18.	Refrigeration basics – vapor compression refrigeration cycle, refrigerant properties, COP; Air conditioning (AC) principle and AC ratings.	1			1,2
19.	Basics of brakes, couplings, and clutches.	1			1,2
20.	Basics of power transmission elements –belt, chain, rope and gear drive systems.	1			1,2

	UNIT V – MATERIALS AND PROPERTIES	3			1,2
21.	Engineering materials and their classification.	1			1,2
22.	Stress-strain relationship, tensile and compression test.	1			1,2
23.	Mechanical properties of materials, material failure.	1			1,2
	ENGINEERING ESSENTIALS	3			4,5
24.	Business ethics and values (Guest lecture).	1			4
25.	Basics of Engineering graphics - Projections of points, lines and planes, Orthographic Projections: front, top, side; sectional views (Guest lecture).	2			5
	DESIGN PROJECT	12			
26.	Selection of team project; guidance in project execution.	12			
	Total contact hours	45			

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

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

CDC 204	Quantitative Aptitude	L	T	P	C
		1	0	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 student's mathematical techniques and problem-solving skills which are required for their carrier building.
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LEARNING OBJECTIVES		STUDENT OUTCOMES					
At the end of the course, student will be able to		D	F	G	I		
1.	To get equipped with basic English grammar.						
2.	Applying numerical competence to day to day communication.						
3.	Competent to communicate idea in English.						
4.	Achieve target audience's attention and confidence.						
5.	To get equipped with basic numerical ability.						
6.	Applying numerical competence to real life problems.						
7.	Operational strategy using logic and reasoning.						
8.	Executing a new model integrating quantitate aptitude.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: QUANTITATIVE REASONING	5			
1.	Number properties. Percentage.	1	I, O	5, 6	1, 2, 3
2.	Ratio and proportion. Profit and loss.	1	I, O	5, 6	1, 2, 3
3.	Simple and compound interest. Averages, Speed, Time and work.	1	I, O	5, 6	1, 2, 3
4.	Powers and roots. Linear equations, Quadratic equations.	1	I, O	5, 6	1, 2, 3
5.	Pipes, cisterns.	1	I, O	5, 6	1, 2, 3
	UNIT II- VERBAL REASONING	6			
6.	Proposition.	1	I, O	1, 2	1, 2, 3

7.	Premise: Syllogism: Verbal Analogies.	1	I, O	1, 2	1, 2, 3
8.	Verification of truth of the statement,	1	I, O	1, 2	1, 2, 3
9.	Assertion and reason.	1	I, O	1, 2	1, 2, 3
10.	Situation reaction test, Decision making.	1	I, O	1, 2	1, 2, 3
11.	Alpha-numerical sequence puzzle.	1	I, O	1, 2	1, 2, 3
	UNIT III: VERBAL ABILITY	2			
12.	Preposition. Articles, Adverbs, Adjectives.	1	I, O	1, 2	1, 2, 3
13.	Conjunctions and Parallel Structures.	1	I, O	1, 2	1, 2, 3
	UNIT IV: DATA ANALYSIS AND INTERPRETATION	2			
14.	Statistics: Average, Median, Mode.	1	I, O	6, 7	1, 2, 3
15.	Range, Standard deviation.	1	I, O	6, 7	1, 2, 3
	Total contact hours	15			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication.
2.	P. Anand, Quantitative Aptitude, Wiley, 2015
3.	Archana Ram, Placementor, Oxford Publication, 2018

Course nature		Theory		
Assessment Method (Weightage 100%)				
In-semester	Assessment tool	Mid Exam I	Mid Exam II	Total
	Weightage	25%	25%	50%
End semester examination Weightage: 50%				50%

SEMESTER- IV

EEE 203	CONTROL SYSTEMS DESIGN	L	T	P	C
		2	1	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	Differential Equations				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

PURPOSE	To provide in-depth knowledge of concepts from classical control theory, understand the concept of transfer function and use it for obtaining system response, analyze dynamic systems for their stability and performance, and design controllers based on stability and performance requirements.
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LEARNING OBJECTIVES		STUDENT OUTCOMES					
At the end of the course, student will be able to							
1.	To model, analysis and design of linear feedback control systems.						
2.	To analyze the time response of first and second order systems						
3.	To investigate the stability of closed loop systems						
4.	To understand the frequency response approaches for the analysis of linear time invariant (LTI) systems						
5.	To discuss basic aspects of PID controller design						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction to Control Systems	9			1,2,& 3
1.	Introduction, Types of Control Systems, Effect of Feedback Systems	1	C		1,2,& 3
2.	Modelling of Physical Systems	2	C		1,2,& 3
3.	Transfer functions	2	C		1,2,& 3

4.	Block diagrams	2	C		1,2,& 3
5.	Signal Flow graphs.	2	C		1,2,& 3
	UNIT-II Time Response of feedback control systems	9			1,2,& 3
6.	Standard test signals	1	C,D		1,2,& 3
7.	Unit step response of First and Second order Systems	1	C,D		1,2,& 3
8.	Time response specifications	2	C,D		1,2,& 3
9.	Time response specifications of second order systems	2	C,D		1,2,& 3
10.	Steady state errors and error constants.	1	C,D		1,2,& 3
11.	Illustrative examples.	2	C		1,2,& 3
	UNIT- III Stability analysis	9			
12.	Concepts of stability, Necessary conditions for Stability.	1	C		1,2,& 3
13.	Routh stability criterion, Relative stability analysis.	1	C		1,2,& 3
14.	Routh stability criterion, Introduction to Root-Locus Techniques.	1	C,D		1,2,& 3
15.	The root locus concepts	2	C,D		1,2,& 3
16.	Construction of root loci.	2	C,D		1,2,& 3
17.	Illustrative examples.	2	C,D		1,2,& 3
	UNIT-IV Frequency domain analysis and stability	10			
18.	Correlation between time and frequency response	1	C		1,2,& 3
19.	Bode Plots	2	C,D		1,2,& 3
20.	Experimental determination of transfer function	1	C,D		1,2,& 3

21.	Introduction to polar and inverse polar plots	1	C,D		1,2,& 3
22.	Nyquist stability criterion	2	C,D		1,2,& 3
23.	assessment of relative stability: gain margin and phase margin.	2	C,D		1,2,& 3
	UNIT – V Compensators and PID Controller	7			
24.	Introduction to lead, lag and lead-lag compensating networks	2	C,D		1,2,& 3
25.	Design of closed loop systems using compensation techniques in time domain and frequency domain	2	C,D		1,2,& 3
26.	Proportional-integral (PI) controller.	1	C,D		1,2,& 3
27.	Proportional-derivative (PD) controller.	1	C,D		1,2,& 3
28.	Proportional-integral- derivative (PID) controller	1	C,D		1,2,& 3
	Total contact hours	45			

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

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

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Time response of Second order system	2			1,2
2.	Effect of P, PD, PI, PID Controller on a second order systems	2			1,2
3.	Lag and lead compensation – Magnitude and phase plot	2			1,2
4.	DC position control system	2			1,2
5.	Transfer function of DC motor	2			1,2
6.	Temperature controller using PID	2			1,2
7.	Characteristics of DC servo motor	3			1,2
Total contact hours		15			

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

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

PURPOSE	The purpose of the course is to enable the students to understand the characteristics of DC Machines and analyze their performance under different testing conditions.						
LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							
a.	Understand the construction and working principle of DC machines						
b.	Understand the armature reaction and commutation in DC machines						
c.	Distinguish different types and identify DC machine for a given application						
d.	Test performance of different DC machines.						
e.	Understand the operation of single phase transformer and voltage regulation.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I CONSTRUCTION, WORKING OF D.C. GENERATORS AND EXCITATION METHODS	9			1 to 5
1.	D.C. Generators - Constructional details, Principle of operation	2			
2.	Action of commutator; Design of armature windings types - lap and wave windings, parallel paths for lap and wave winding;	4			
3.	E.M.F equation - Problems; Methods of excitation of generators - Separately excited and self-excited; Causes of failure to self-excitation and remedial measures.	3			
	UNIT-II TYPES OF D.C. GENERATORS, ARMATURE REACTION AND COMMUTATION	9			1 to 5
4.	Types of generators - Shunt, Series and compound, Problems;	2			
5.	Armature reaction - Effect of armature reaction, Cross magnetizing and demagnetizing AT/pole, Compensating winding, Interpoles;	4			
6.	Commutation process, Methods to improve commutation.	3			
	UNIT- III CHARACTERISTICS OF D.C. GENERATORS, WORKING OF D.C. MOTORS, TYPES, AND STARTERS.	9			1 to 5
7.	Build-up of E.M.F under no load, Critical field resistance and critical speed,	1			

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

LEARNING RESOURCES

TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

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

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

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.	1			1,2
2.	Load test on separately excited DC generator	1			1,2
3.	To study the characteristics of a dc shunt motor	1			1,2
4.	Speed Control of DC Motor: Field control, Armature control	2			1,2
5.	Swinburne's test and separation of losses in DC Machine	2			3,4
6.	Brake test on DC shunt motor. Determination of performance curves	1			3,4
8.	Hopkinson's test on DC shunt machines	1			3,4
9.	OC & SC test on single phase transformer	2			3,4
10.	Sumpner's test on single phase transformer	2			3,4
11.	Load test on single-phase transformers	2			3,4
Total contact hours		15			

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

ECE 221	Analog Electronics	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	Electronic Circuits				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Engineering Science				
<i>Course designed by</i>	Department of ECE				
<i>Approval</i>					

PURPOSE	To give the idea about fundamental properties of analog circuits and systems. To prepare students to perform the analysis of any analog electronic circuit. To empower students to understand the design and working of BJT/MOSFET amplifiers, oscillators and operational amplifiers. To prepare students for advanced courses in communication system circuit design.						
LEARNING OBJECTIVES	STUDENT OUTCOMES						
At the end of the course, student will be able to							
1. Develop the ability to understand, analyze and design practical circuits based on BJT and MOSFETs.							
2. Able to design amplifier circuits using MOSFET and BJT also will be able to understand the frequency response of the amplifiers.							
3. Understand the effect of positive and negative feedback on different parameters of amplifiers.							
4. Develop the skill to design, build and trouble shoot practical analog circuits which are building blocks of all modern analog and Mixed signal ICs							

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

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

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

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

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Analysis of Feedback circuits with Op-amps.	1	C-D-I-O		1,2,3
2.	Analysis of Feedback circuits with MOSFETs.	1	C-D-I-O		1,2,3
3.	Design and Analysis of RC phase shift, LC oscillators.	2	C-D-I-O		1,2,3
4.	Design and Analysis of Wien Bridge oscillator.	1	C-D-I-O		1,2,3
5.	Design and Analysis of 555 timer based Astable and Monostable Multivibrators.	2	C-D-I-O		1,2,3
6.	Design and Analysis of MOSFET based Class A, Class B, Class AB Power amplifier.	1	C-D-I-O		1,2,3
7.	Design and Analysis of Op-amp based Active filters.	1	C-D-I-O		1,2,3
8.	Design and Analysis of Voltage regulator circuits.	1	C-D-I-O		1,2,3
9.	Design and Analysis of Voltage reference circuits.	1	C-D-I-O		1,2,3
10.	Design and Analysis of ADCs, DACs-I.	2	C-D-I-O		1,2,3
11.	Design and Analysis of ADCs, DACs-II.	1	C-D-I-O		1,2,3
12.	Course project	3	C-D-I-O		1,2,3
Total contact hours		15			

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

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

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

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				
1.	Introduction, Geometry of Linear Equations.		C		1
2.	Gaussian Elimination.		C		1
3.	Matrix Notation and Matrix Multiplication.		C		1
4.	Triangular Factors and Row Exchanges.		C		1
5.	Inverses and Transposes.		C		1
	Unit II - Vector spaces				
6.	Vector spaces and Subspaces.		C		1
7.	Solving $Ax = 0$ and $Ax = b$.		C		1
8.	Linear Independence, Basis and Dimension.		C		1
9.	The Four Fundamental Subspaces.		C		1
10.	Graphs and Networks, Linear Transformations.		C		1
	Unit III - Orthogonality				
11.	Orthogonal Vectors and Subspaces.		C		1

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

LEARNING RESOURCES

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

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

ENG 105 L	Engineering Graphics Lab	L	T	P	C
		0	0	2	1
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	P				
<i>Course designed by</i>	DEPARTMENT OF MECHANICAL ENGINEERING				
<i>Approval</i>	-- Academic Council Meeting -- , 2016				

PURPOSE							
LEARNING OBJECTIVES							STUDENT OUTCOMES
At the end of the course, student will be able to							
1.	Understand the GUI and hands on lab experience on CAD software						
2.	Create the 3d models of the Engineering components						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I	2			
1.	GUI familiarity, features, commands	1			1
2.	shortcuts, mouse features, drop down menus etc.	1			1
	UNIT-II	3			
3.	Sketch entities Inference line, centerline, line, circle, arc, ellipse	1			1
4.	Rectangle, slots, polygon, spline, points, text, snap, grid Sketch Tools Fillet, chamfer, offset, trim	1			3
5.	Extend, mirror, copy, rotate, scale, sketch	1			2
	UNIT- III	2			
6.	Blocks, create blocks, add/remove, explode	1			2
7.	Relations, dimensioning	1			1,2
	UNIT-IV	2			
8.	Part modeling, extrude, revolve, swept, extruded cut	1			1,2
9.	loft, reference, curves, fillet, pattern	1			2
	UNIT – V	2			
10.	Assembly modeling, mating	1+1			2

11.	manipulating components	1			1
	UNIT – VI	1			
12.	Surface modeling tools	1			4
	UNIT – VII	2			
13.	All views of the object, dimensions	1			1,2,3
14.	Drafting tools	1			2
	UNIT – VIII	1			
15.	Simulation express, stress-strain analysis	1			5
Total contact hours		15			

LEARNING RESOURCES	
TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Solid works user manual https://www.solidworks.com/sw/docs/Student_WB_2011_ENG.pdf
2.	Solid works user manual https://my.solidworks.com/solidworks/guide/SOLIDWORKS_Introduction_EN.pdf
3.	https://drive.google.com/file/d/104MtoupAMP6_-8-xYICBT4hMZKuOL0Nw/view
4.	http://www.solidworksthai.com/board/attachments/Solidworks_-_Surface_Modeling.pdf
5.	https://static.sdcpublishations.com/pdfsamples/978-1-58503-710-0-2.pdf

CDC 203	Verbal Ability	L	T	P	C
		1	0	0	1
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Skill Building				
<i>Course designed by</i>	Department Of Career Development Centre				
<i>Approval</i>					

PURPOSE	A grasp over numeric skills enable an individual to apply the mathematical techniques to situations that call for the interpretation or evaluation of quantitative information. The logical ability is sharpened through the practice of quantitative reasoning. Emotional intelligence on the other hand enables the development of intra and interpersonal relationship skills. Both these disciplines are aimed at enhancing the professional and personal effectiveness of the students.
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LEARNING OBJECTIVES		STUDENT OUTCOMES					
At the end of the course, student will be able to		D	F	G	I		
1.	To get equipped with basic English grammar.						
2.	Applying numerical competence to day to day communication.						
3.	Competent to communicate idea in English.						
4.	Achieve target audience's attention and confidence.						
5.	To get equipped with basic numerical ability.						
6.	Applying numerical competence to real life problems.						
7.	Operational strategy using logic and reasoning.						
8.	Executing a new model integrating quantitate aptitude.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Quantitative Reasoning	3			
1.	Number properties Speed, Time and work	1	C-I-O		1,2
2.	Powers and roots Pipes, cisterns Problems on Clock	1	C-I-O		1,2
3.	Calendar and Cubes Height and Distance Logarithms	1	C-I-O		1,2
	UNIT-II Non-Verbal Reasoning	3			
4.	Alpha-numerical sequence puzzle	1	C-I-O		1,2
5.	Symbols and their relationships, Blood Relations	1	C-I-O		1,2
6.	Seating Arrangement Coding-Decoding, Input- Output, test Direction Sense Test	1	C-I-O		1,2

	UNIT- III Data Analysis and Interpretation	3	C-I-O		1,2
7.	Sets and Functions Data Sufficiency	1			
8.	Statistics: Average, Median, Mode, Range, Standard deviation Graphical and Numerical Methods for Describing Data	1	C-I-O		1,2
9.	Interpretation of data in tables and graphs Permutations and Venn diagrams Counting Methods, Probability	1	C-I-O		1,2
	UNIT-IV Emotional Intelligence II	3			
10.	Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation	3	C-I-O		1,2
	Total contact hours	15			

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	R.S. Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication
2.	P. Anand, Quantitative Aptitude, Wiley, 2015
3.	The Games People Play, Eric Berne; Grove Press; 1964
4.	Of Human Interaction; Joseph Luft; Mayfield Publishing. 1969
5.	Emotional Intelligence; Daniel Goleman; Bantam Books, 1995

Course nature		Theory		
Assessment Method (Weightage 100%)				
In-semester	Assessment tool	Mid Exam I	Mid Exam II	Total
		Weightage	25%	25%
End semester examination Weightage: 50%				50%

CSE 230	INDUSTRY STANDARD CODING PRACTICE - I	L	T	P	C
		0	0	4	1
<i>Co-requisite:</i>	Computer Lab/ Laptop				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	Listed in Reference				
<i>Course Category</i>	Engineering Sciences				
<i>Course designed by</i>	As per the industry Norms by CCC				
<i>Approval</i>					

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.
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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 test case scenarios.				1,2
	UNIT-IV	8			

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

LEARNING RESOURCES

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

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

SEMESTER V

EE 301	AC Machines	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department OF Electrical and Electronics Engineering				
<i>Approval</i>					

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.
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LEARNING OBJECTIVES		STUDENT OUTCOMES							
At the end of the course, student will be able to									
1.	Understand the operation of transformers and induction motors.								
2.	Perform suitable tests on transformers to analyze the characteristics								
3.	Perform suitable tests on induction motors to analyze the characteristics								
4.	Understand different starting methods of three phase induction motors.								
5.	Understand different speed control techniques of three phase induction motors.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Fundamentals of AC machine windings	9			
1.	Physical arrangement of windings in stator and cylindrical rotor; slots for windings	2			3&4
2.	Single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis	2			3&4
3.	3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed	3			3&4
4.	Sinusoidally distributed winding, winding distribution factor	2			3&4
	UNIT-II Pulsating and revolving magnetic fields	9			
5.	Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement	2			3&4
6.	Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings	3			3&4
7.	Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields	2			3&4
8.	Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving	2			

	magnetic field				
	UNIT- III Induction Machines	9			3&4
9.	Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque	2			3&4
10.	Equivalent circuit. Phasor Diagram, Losses and Efficiency	2			3&4
11.	Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency)	3			
12.	Methods of starting, braking and speed control for induction motors. Generator operation	1			3&4
13.	Self-excitation. Doubly-Fed Induction Machines	1			3&4
	UNIT-IV Single-phase induction motors	9			
14.	Constructional features	2			3&4
15.	Double revolving field theory	2			3&4
16.	Equivalent circuit	2			3&4
17.	Determination of parameters	1			3&4
18.	Split-phase starting methods and applications	2			3&4
	UNIT – V Synchronous machines	9			
19.	Constructional features, cylindrical rotor synchronous machine - generated EMF	2			3&4
20.	Equivalent circuit and phasor diagram, armature reaction, synchronous impedance voltage regulation	3			3&4
21.	Operating characteristics of synchronous machines, V-curves	1			3&4
22.	Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics	2			3&4
23.	Parallel operation of alternators - synchronization and load division	1			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
6.	P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

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%

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Brake test on 3-ph squirrel cage Induction Motor	1			1 & 2
2.	Load test on 3-ph AC slip ring Induction Motor	1			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	1			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	1			1 & 2
Total contact hours		15			

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

EE 304	Fundamentals of Power System	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical & Electronics Engineering				
<i>Approval</i>					

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							
1.	Know the different elements of electric power supply system						
2.	Understand the constructional features of different types of overhead lines and insulators						
3.	Understand the constructional features of different types of underground cables						
4.	Learn the computation of transmission line resistance, inductance, and capacitance						
5.	Know about the DC and AC distribution systems						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Supply Systems	7			
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	1			3
3.	Comparison of conductor material in underground system, Comparison of various systems of transmission	1			3
4.	Elements of a transmission line, Economics of power transmission, Economical choice of conductor size	2			3
5.	Economic choice of transmission voltage, Requirement of satisfactory electric supply	1			3
	UNIT-II Mechanical Design of Transmission Lines	6			

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 and sag calculations	2			2, 3, 4
	UNIT- III: Inductance and Resistance of Of Transmission Line	7			
9.	Introduction, Definition of Inductance, Flux Linkages of isolated current carrying conductor	2			1, 2, 3, 4
10.	Inductance of a single phase two wire line, Conductor types, Flux Linkages of one conductor in group	2			1, 2, 3, 4
11.	Inductance of composite conductor lines, Inductance of three phase lines, Double circuit three phase lines	2			1, 2, 3, 4
12.	Bundled conductors, Resistance, Skin effect and Proximity effect, Magnetic field induction	1			1, 2, 3, 4
	UNIT-IV Capacitance of Transmission Lines	6			
13.	Introduction, Electric field of a long straight conductor	1			1, 2, 3, 4
14.	Potential difference between two conductors of a group of parallel conductors	1			1, 2, 3, 4
15.	Capacitance of a two wire line, Capacitance of a three phase line with equilateral spacing	1			1, 2, 3, 4
16.	Capacitance of a three phase line with unsymmetrical spacing, Effect of earth on transmission line capacitance	2			1, 2, 3, 4
17.	Method of GMD, Bundled conductors, Electrostatic induction	1			1, 2, 3, 4
	UNIT – V DC and AC distribution	7			
18.	Distribution system, classification of Distribution systems, AC distribution, DC distribution, Connection scheme of distribution system	2			3, 4
19.	Types of DC distributors, DC distribution calculations, DC distributor fed at one end, uniformly loaded distributor fed at one end	2			3, 4
20.	distributor fed at both ends, Distributor with both concentrated and uniform loading, Ring distributor, Ring main distributors with interconnector	1			3, 4

21.	AC distribution calculations, Methods of solving AC distribution problems	1			3, 4
22.	3-phase unbalanced loads – 4 wire, Star connected unbalanced loads, Ground detectors	1			3, 4
	UNIT – VI Representation of power system component	6			
23.	Introduction, Single phase Representation of balanced three phase networks, The one line diagram and impedance or reactance diagram	2			
24.	Per unit system, Advantages of pu system, Per unit representation of a transformer, Per unit impedance diagram of a power system	1			
25.	Complex power, The steady state model of synchronous Machine, Power factor and power control, Salient pole synchronous generator	1			
26.	Loading capability diagram [3], Power transformer, Transmission of electric power, System protection , Representation of load	2			
	UNIT – VII Underground cables	6			
27.	Underground cables, Construction of cables, Classification of cables	1			3, 4
28.	Cables for three phase services, Insulation resistance of a single core cable	1			3, 4
29.	Capacitance of a single core cable, Dielectric stresses in a single core cable	1			3, 4
30.	Most economical conductor size in a cable, Grading of cables, Capacitance grading and inter sheath grading	2			3, 4
31.	Capacitance of threescore cable and measurement of capacitance	1			3, 4
	Total contact hours				45

LEARNING RESOURCES

TEXT BOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Modern Power System Analysis by D P Kothari and I J Nagrath : Fourth Edition: McGraw Hill.
2.	Principles of Power System by V.K.Mehta and RohitMehta : Reprint 2014 : S. Chand.
3.	Power Systems Analysis : John J. Grainger and W. D. Stevenson Jr., Tata McGrawHill International.
4.	Electrical Power systems: C. L .Wadhwa, 5th Edition, New Age InternationalPublisher.
5.	J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
6.	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
7.	A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.

8.	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.
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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%

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/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Modern Power System Analysis by D P Kothari and I J Nagrath : Fourth Edition: McGraw Hill.
2.	Principles of Power System by V.K.Mehta and RohitMehta : Reprint 2014 : S. Chand.
3.	Power Systems Analysis : John J. Grainger and W. D. Stevenson Jr., Tata McGrawHill International.
4.	Electrical Power systems: C. L .Wadhwa, 5th Edition, New Age InternationalPublisher.
5.	J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.

6.	O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
7.	A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
8.	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

EE 305	Advanced Control Systems Design	L	T	P	C
		2	0	2	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	Differential Equations (MAT 131), Linear Algebra (MAT 211), Control Systems Design (EE 203)				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

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.							
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Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I State Variable Analysis and Design	13			1,2,& 3
1.	Review of classical control system.	2	C		1,2,& 3
2.	Analysis in state-space: A perspective on state-space design.	1	C		1,2,& 3
3.	State variables, State models for physical systems.	1	C		1,2,& 3
4.	SISO and MIMO systems.	1	C		1,2,& 3
5.	Solution of state equations. Transfer function.	1	C		1,2,& 3
6.	Eigenvalues and eigenvectors.	1	C		1,2,& 3
7.	Jacobian linearization technique.	1	C		1,2,& 3
8.	State transformations and diagonalization.	1	C		1,2,& 3
9.	Transformation to phase-variable canonical form.	1	C		1,2,& 3
10.	Controllability and observability.	1	C		1,2,& 3
11.	Duality property.	1	C		1,2,& 3
12.	Illustrative Problems	1	C, D		1,2 & 3
	UNIT-II Pole Placement Design and State Observers	6			1,2,& 3
13.	Introduction	1	C,D		1,2,& 3
14.	Stability Improvements by State Feedback	1	C,D		1,2,& 3

15.	Necessary and Sufficient Conditions for Arbitrary Pole Placement.	1	C,D		1,2,& 3
16.	State Regulator Design	1	C,D		1,2,& 3
17.	Design of State Observer.	1	C,D		1,2,& 3
18.	Compensator Design by the Separation Principle.	1	C,D		1,2,& 3
	UNIT- III Non-linear Systems Analysis	8			
19.	Common Nonlinear System Behaviors.	1	C		1,2,& 3
20.	Common Nonlinearities in Control Systems.	1	C,D		1,2,& 3
21.	Describing Functions of Common Nonlinearities.	1	C,D		1,2,& 3
22.	Stability Analysis by Describing Function Method.	2	C,D		1,2,& 3
23.	Concept of Phase Plane Analysis.	1	C,D		1,2,& 3
24.	Construction of Phase Portraits, System Analysis on the Phase Plane.	1	C,D		1,2,& 3
25.	Variable Structure Systems.	1			
	UNIT-IV Lyapunov's Stability Analysis	5			
26.	Introduction	1	C		1,2,& 3
27.	Lyapunov's Stability Criteria	1	C,D		1,2,& 3
28.	The direct method of Lyapunov stability.	1	C,D		1,2,& 3
29.	Methods of constructing Lyapunov Function for Non-linear Systems.	1	C,D		1,2,& 3
30.	Illustrative examples.	1	C,D		1,2,& 3
	Total contact hours	32			

LEARNING RESOURCES

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

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

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

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

PHY 113	Field Theory	L	T	P	C
		3	0	0	3
<i>Co-requisite:</i>	NA				
<i>Prerequisite:</i>	Multivariable Calculus (MAT 121)				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	BS Electives				
<i>Course designed by</i>	Department of Physics				
<i>Approval</i>					

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 Gauss's 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.	Poynting 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 & Poynting 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.	Reflection 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 MATERIAL ^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, 4 th Edition (2015) Publisher - Pearson Education India Learning Private Limited
3 ^a	Electromagnetic Field Theory Fundamentals - B S Guru & H R Hiziroglu, 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 313	Microprocessors and Interfacing	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Engineering Science				
<i>Course designed by</i>	Department of Electronics and Communication Engineering				
<i>Approval</i>					

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%

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-bit numbers (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	<u>8086 INTERFACING PROGRAMS:</u>	3	C-D-I-O		1, 2, 3

	<p>10.(a) ALP to interface 8086 with 8255 for control of stepper motor.</p> <p>(b)ALP to interface 8086 with 8279 for 7-segment display.</p> <p>(c)ALP to interface 8086 with 8255 to implement traffic light model</p> <p>(d) ALP to interface 8086 with elevator.</p> <p>(e) ALP to interface 8086 with DDAC.</p>				
	Total contact hours	15			

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

EE 303	Numerical Methods	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>					
<i>Data Book / Codes/Standards</i>	Approved Steam Tables, Refrigeration Tables and Psychometric Chart.				
<i>Course Category</i>	Engineering Sciences				
<i>Course designed by</i>	Department of Mechanical Engineering				
<i>Approval</i>					

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

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: CURVE FITTING/ NUMERICAL SOLUTIONS	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 DIFFERENCES AND INTEGRATION	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 DIFFERENTIATION 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 FIRST 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%

Session	List of Experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Introduction to Numpy and Python.	1			
2.	Python plotting (line plots and contour plots) using Matplotlib.	2			
3.	Solution of linear algebraic equations using Direct methods Solution of linear algebraic equations using Iterative methods, Jacobi, SOR, SUR.	2			
4.	Solution of the equations using Iterative solvers Newton Raphson and Bisection.	2			
5.	Curve fitting using least squares regression (linear and quadratic).	2			
6.	Solution of ordinary differential Equation using Euler, RK2 – (Heun and midpoint),RK4	2			
7.	Differentiation of a function using central, forward, backward Finite difference methods	2			
8.	Solution of the Partial differential equations (Laplace equation of temperature distribution) using the Finite difference method.	2			
TOTAL HOURS		15			

CDC 331	Employability Skills	L	T	P	C
		1	1	0	0
<i>Co-requisite:</i>	Nil				
<i>Prerequisite:</i>	NIL				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Skill Building				
<i>Course designed by</i>	Department of Career Development Centre				
<i>Approval</i>					

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%
End semester examination Weightage : 50%						50%

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

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.
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LEARNING OBJECTIVES

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

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

STUDENT OUTCOMES

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

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

	Sorting Algorithms, Industry Standard Practice Questions.				
	UNIT-III	8			
3.	Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.				1
	UNIT-IV	12			
4.	Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms & Industry Standard Practice Questions.				1,2
	UNIT-V	12			
5.	Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.				3,4,5
	Total contact hours	48			

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

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

SEMESTER- VI

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

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

TEXTBOOKS {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 1	CLA 2	Total
	Weightage	15%	15%	10%	10%	50%
End semester examination Weightage: 50%						50%

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

PURPOSE	To study the basic principles and operations of different power electronic converters such as dc/ac, ac/dc, ac/ac, and dc/dc.
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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	3	C		1&2

	diode –continuous and discontinuous conduction.				
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 converter in 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%

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%
End semester examination Weightage: 50%					50%

EEE 309	Synchronous Machines	L	T	P	C
		2	0	2	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	AC machines, Fundamental of power systems				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical Engineering				
<i>Approval</i>					

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 excitation, Effect of change in prime mover torque, Influence of 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	
	TEXTBOOKS/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%

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

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

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

PURPOSE	The nuclear power generation course provides a graduate-level understanding of the nuclear engineering, nuclear reactors, materials, waste disposal and various safety rules.
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LEARNING OBJECTIVES		STUDENT OUTCOMES							
At the end of the course, student will be able to									
a)	understand basic concepts like atomic mass, atomic number, radioactive decay								
b)	different types and components of nuclear reactor								
c)	understand nuclear materials like fuel cladding, moderator, control rod, shielding material and their application								
d)	Understand about nuclear waste disposal and radiation protection.								

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Nuclear Engineering	9			
1.	Why Nuclear power, atomic nuclei, atomic mass, atomic number, isotopes	2			1-3
2.	Radioactivity and radioactive change, rate of radioactive decay, mass energy equivalence	2			1-3
3.	Binding Energy, Release of Energy by Nuclear Reaction	1			1-3
4.	Types of Nuclear Reactions	2			1-3
5.	Nuclear Cross – section, Nuclear Fission, Fission Chain Reaction,	2			1-3
6.	Fertile Materials and Breeding	2			1-3
	UNIT II: Nuclear Reactor Power Generation	9			
7.	Nuclear Power Systems	2			1-3
8.	Classification of Nuclear Reactors	2			1-3

9.	General Components of nuclear reactors	2			1-3
10.	Power of a nuclear reactor	2			1-3
11.	Comparison of nuclear plants and thermal plants	2			1-3
12.	India's 3 stage Nuclear Power programme	1			1-3
	UNIT-III: Types of nuclear reactors	9			
13.	Different types of reactors	1			1-3
14.	Pressurized Water Reactor (PWE)	2			1-3
15.	Boiling Water Reactor (BWR)	2			1-3
16.	CANDU (Canadian Deuterium Uranium) Reactor	2			1-3
17.	Gas cooled reactor	2			1-3
	UNIT IV: Nuclear Materials	9			
18.	Introduction	1			1-3
19.	Fuels,	1			1-3
20.	Cladding and Structural Materials Coolants	2			1-3
21.	Moderating and reflecting materials	2			1-3
22.	Control Rod and Shielding Materials	2			1-3
	UNIT-V: Nuclear waste, disposal, and Safety	9			
23.	Nuclear Radiation-Unit, Types of Nuclear Waste	2			1-3
24.	Effects of nuclear radiation	1			1-3
25.	Radioactive waste disposal system	2			1-3
26.	Personal Monitoring	1			1-3
27.	Radiation Protection,	2			1-3
28.	Radiation Dose	2			1-3
	Total contact hours		45		

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

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

EEE 311	Nonlinear Systems and Control	L	T	P	C
		3	0	0	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	1. Differential Equations (MAT 131) 2. Control Systems (EEE 203) 3. Advanced Control Systems (EE 305)				
<i>Data Book / Codes/Standards</i>	NIL				
<i>Course Category</i>	Technical Elective				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

PURPOSE							
LEARNING OBJECTIVES							STUDENT OUTCOMES
At the end of the course, student will be able to							
1.	The course is related to the study of stability of various linear and nonlinear input-output systems						
2.	Important concepts such as phase plane method, describing function methods, Lyapunov stability criterion, optimal control and adaptive control techniques will also be covered in this course						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT-I Introduction to Nonlinear Systems	9			
1.	Review of controllability and observability	1			
2.	Nonlinear Systems, Properties	1			
3.	Physical Nonlinearities	1			
4.	Describing Functions of Certain Physical Nonlinearities such as Ideal Relay, Saturation, Dead zone	2			
5.	Hysteresis Black lash, Ideal Relay with Dead Zone, Saturation with Dead Zone, Ideal Relay with Hysteresis	2			
6.	Ideal Relay with Dead Zone and Hysteresis, Combined Coulomb Friction and Viscous Friction, Combined Coulomb and Viscous Friction with Dead Zone.	2			
	UNIT-II Phase Plane Analysis	9			
7.	Phase Plane and Phase Trajectory	2			
8.	Analytical Method of Construction of Phase Trajectory	2			

9.	Properties of Phase Trajectories, Graphical Constructions of Phase Trajectory, Limit Cycles, Equilibrium Point, Multiple Equilibria	3			
10.	Qualitative Behavior Near Equilibrium Points, Singular Points and their Classification.	2			
	UNIT- III Stability of Nonlinear Systems	9			
11.	Fundamentals of Lyapunov theory	1			
12.	Nonlinear systems and equilibrium points, Concepts of stability, Linearization, and local stability.	2			
13.	Lyapunov's direct method, Invariant set theorems, Lyapunov analysis of LTI systems, Krasoskii's method.	3			
14.	Variable gradient method. Lyapunov's Stability Analysis for Linear Time Invariant Systems, Input-Output Stability	3			
	UNIT-IV Optimal Control Theory	9			
15.	Introduction, Concept of Optimal Control,	3			
16.	Performance Indices: Minimum Time Problem, Minimum Energy Problem, State Regulator Problem, Output Regulator Problem	3			
17.	Tracking Problems, Relation between Quadratic Performance Index and Lyapunov Functions, State Regulator Design using Lyapunov Equation.	3			
	UNIT – V: Nonlinear Controller Design Methods	9			
18.	Nonlinear Controller Design Methods	3			
19.	The principle of certainty-equivalence. LaSalle/Yoshizawa theorem, Model reference adaptive control, Variable Structure Systems, Sliding Mode Control and Backstepping Control methods.	6			
	Total contact hours		45		

LEARNING RESOURCES	
TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL	
1.	Hassan Khalil, Nonlinear Systems, 3rd Edition, Prentice Hall
2.	M. Vidyasagar, Nonlinear systems analysis. 2nd Edition. Prentice Hall, 1993.

Course nature			Theory			
Assessment Method (Weightage 100%)						
In-semester	Assessment tool	Mid Term I	Mid Term II	CLA 1	CLA 2	Total
	Weightage	20	20	5	5	50
End semester examination Weightage:						50

EEE 312	Renewable Energy Systems	L	T	P	C
		3	0	0	3
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	NIL				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	Technical Elective				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

PURPOSE	The renewable energy systems course provides a graduate-level understanding of the conversion principles and technology behind various renewable energy sources.						
LEARNING OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to							
a.	Describe the environmental aspects of renewable energy sources. Concepts in solving numerical problems pertaining to solar radiation geometry.						
b.	Assess the performance of solar photovoltaic and solar thermal systems.						
c.	Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.						
d.	Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications.						
e.	Understand the role of Tidal, Wave and Ocean energy in the Power Generation.						

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
	UNIT I: Introduction to Energy Sources & Solar Radiation	9			
1.	Introduction about the renewable energy sources, roles and potential of renewable source in India.	1	C		1, 2
2.	Impact of renewable energy generation on environment.	1	C		1, 2
3.	Solar constant, extraterrestrial and terrestrial solar radiation.	1	C		1, 2

4.	Solar radiation - beam and diffuse radiation.	2	C		1, 2
5.	Instruments for measuring solar radiation and sunshine recorder.	2	C		1, 2
6.	Sun-earth geometry and solar angles.	2	C		1, 2
7.	UNIT-II: Thermal Systems & Solar photovoltaic	9			
8.	Introduction to solar Collectors and classifications.	1	C, D		1, 2
9.	Non concentrated collectors.	1	C, D		1, 2
10.	Concentrated collectors.	2	C, D		1, 2
11.	Applications of solar collectors.	1	C, D		1, 2
12.	Operating principle, Photovoltaic cell concepts.	1	C, D		1, 2
13.	PV cell Characteristics, equivalent circuits.	2	C, D		1, 2
14.	Series and parallel connection of identical and non-identical solar cells.	1	C, D		1, 2
15.	UNIT III: Wind Energy	9			
16.	Wind energy, Wind energy conversion.	1	C, D		1, 3
17.	Power and energy from wind turbine.	2	C, D		1, 3
18.	Performance characteristics.	1	C, D		1, 3
19.	Betz criteria and effect of tower height on wind speeds.	3	C, D		1, 3
20.	General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines.	2	C, D		1, 3
21.	UNIT-IV: Biomass Energy	9			
22.	Introduction to biomass and biomass energy.	1	C		1, 2, 4
23.	Principles of biomass conversion.	1	C		1, 2, 4
24.	Photosynthesis.	1	C		1, 2, 4
25.	Combustion and fermentation.	1	C		1, 2, 4
26.	Anaerobic and aerobic digestion.	2	C		1, 2, 4
27.	Types of biogas digester.	2	C		1, 2, 4

28.	Wood gassifier, Pyrolysis and Applications.	1	C		1, 2, 4
29.	UNIT V: Tidal, Wave and Ocean Energy	9			
30.	Tidal Energy: Energy from the tides, basic Barage and Non Barage Tidal power systems.	2	C		1, 4
31.	Environmental Impact of tidal energy.	1	C		1, 4
32.	Wave Energy: Energy from waves.	1	C		1, 4
33.	Wave power devices.	1	C		1, 4
34.	Environmental Impact.	1	C		1, 4
35.	Ocean Thermal Energy Conversion (OTEC).	1	C		1, 4
36.	Types of OTEC and applications.	2	C		1, 4
Total contact hours		45			

LEARNING RESOURCES	
	TEXTBOOKS^a/REFERENCE BOOKS^b
1 ^a	G. D. Roy: Non-Conventional Energy Sources, Khanna Publishers.
2 ^a	S. P. Sukhatme and J. K. Nayak: Solar Energy, Tata Mc Graw Hill, New Delhi, 4 th Edition.
3 ^b	John Twidell and Tony Weir: Renewable Energy Resources, Taylor and Francis, 2 nd Edition, London, 2010.
4 ^b	Solanki: Renewable Energy Technologies: Practical Guide For Beginners, PHI Learning Pvt. Ltd., 2008.

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

ENV 111	Environmental Science	L	T	P	C
		2	0	2	3
Co-requisite	NIL				
Prerequisite	NIL				
Data Book / Codes /Standards	NIL				
Course Category	Humanity 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	1	C,D	4	1,3

	pollution, bio-magnification Wastewater treatment, Methods of water purification				
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 (3 rd edition), Oxford University Press.
2.	Deeksha Dave, S.S. Katewa (2012). Textbook of Environmental Studies (2 nd 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%				

List of Experiments

Session	Description of the Topic/Experiment	Contact hours	C-D-I-O	IOs	Reference
	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
	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
	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
	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. <i>Journal of Materials Chemistry A</i> , 4(19), 7207-7213.

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

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

PUR-POSE	To impart knowledge and equip with skills and aptitude that will enable learners ace competitive exams and placement tests with speed and precision.						
LEARNING OBJECTIVES				STUDENT OUTCOMES			
At the end of the course, student will be able to							
a.	Enhance lexical skills through systematic application of concepts and careful analysis of style, usage, syntax, semantics and logic.						
b.	Build vocabulary through methodical approaches and nurture passion for learning new words.						
c.	Helps students create a communication strategy.						
d.	Enable students to draft and design a resume and cover letter. Enable the students to handle the interview process effectively.						

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

7.	Para jumbles, Sentence Completion & Text Completion.	3	C and I		1
8.	Reading Comprehension, Identification of errors, Sentence correction.	3	C and I		2
	UNIT-IV	6			
9.	Resume writing.	3	C and I		5,6
10.	Cover letter.	3	C and I		5,6
	UNIT-V	6			
11.	GD.	3	C and I		5
12.	PI.	3	C and I		5
	Total contact hours	30			

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

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

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.
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LEARNING OBJECTIVES

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

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

STUDENT OUTCOMES

- Able to understand test and development aspects of programming by solving problems at Industry standards.
- Able to interpret any given problem using required domain skills, mathematics.
- Able to learn applicable methods to optimize solutions for any given problem.
- Able to develop programs using C / any language with data structures.
- Able to develop programs using C, python / any preferred language until advanced algorithms with test driven development approach
- 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
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Assessment Method (Weightage 100%)				
In-semester	Assessment tool	Mid Term test I	Mid Term test II	Total
		Weightage	25%	25%
End semester examination Weightage: 50%				50%

SEMESTER VII

EEE 403	Switch Gear and Protection	L	T	P	C
		3	0	2	4
<i>Co-requisite:</i>	NIL				
<i>Prerequisite:</i>	1. EE 301 AC Machines 2. EE 304 Fundamentals of Power Systems				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

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 lightning 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%

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
<i>Co-requisite:</i>	Switchgear and Protection (EE 403)				
<i>Prerequisite:</i>	Fundamentals of Power Systems (EE 304) Field Theory -OE Elective (PHY 112) TE -Numerical Methods (ME 132)				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	Core				
<i>Course designed by</i>	Department of Electrical and Electronics Engineering				
<i>Approval</i>					

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

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

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

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

12.	Generation of ac high voltage, cascade transformer, resonant transformer.	3	C		1-3
13.	Definition of impulse voltage.	1	C		1-3
14.	Generation of impulse voltage.	2	C		1-3
15.	Illustrative examples.	1	C		1-3
UNIT IV: Measurement techniques in high voltage		9			
16.	Measurement of dc voltage using resistance and capacitance potential dividers.	2	C		1-3
17.	Measurement of high ac voltage.	2	C		1-3
18.	Measurement of currents, using resistive shunts, current transformers and Rogowski coil.	3	C		1-3
19.	Illustrative examples.	2	C		1-3
UNIT-V: Testing of electrical equipment		9			
20.	Introduction to testing of insulators and bushings.	2	C		1-3

21.	Power frequency test and impulse test on insulators.	2	C		1-3
22.	Power frequency test and impulse test on bushings.	1	C		1-3
23.	Testing of transformers, impulse testing.	2	C		1-3
24.	Testing of cables.	2	C		1-3
Total contact hours		45			

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

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 $\tan\delta$ 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 detector	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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	Digital electronics, Programming with C						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	P	CORE ELECTIVE	Embedded Systems and RTOS				
<i>Course designed by</i>	Department of Electronics and Communication Engineering						
<i>Approval</i>							

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	
1. design an application specific processor	
2. design an efficient embedded system with any given processor	
3. 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			
1.	Introduction to embedded systems, examples of embedded systems,	1	C		1,2
2.	Components of embedded systems hardware	1	C		1,2
3.	Design process in embedded system	1	C		1,2
4.	Design metrics, design metrics optimization	1	C		1,2
5.	Time to market, The NRE and unit cost design metrics, The performance design metrics	1	C		1,2
6.	Von Neumann and Harvard Architecture, CISC and RISC architectures	1	C		1,2
7.	Introduction to different controllers: Atmel 89C52, ATMEGA 32, Microchip PIC16F877, ARM 7.	2	C		1,2
	UNIT II : Custom Processor Designs	12			
8.	Processor technology – General-purpose processor, single-purpose processor, and application specific processors	2	C		1

9.	IC Technology – PLD, semi-custom, full custom.	1	C		1
10.	Design Technology – RT Synthesis. RT-level combinational and sequential components.	1	C		1
11.	Finite state machine with data (FSMD)	1	C		1
12.	Finite state machines (FSM)	1	C		1
13.	controller and datapath design	1	C		1
14.	Optimization of design	2	C		1
15.	Operation of general-purpose processors – Instruction execution, pipelining, superscalar and VLIW architectures.	1	C		1
16.	Design of Soda Vending machine	1	C		1
17.	Design of Elevator controller	1	C		1
	UNIT III : ARM Processor – Architecture and Interfacing	13			
18.	Introduction to ARM core, ARM extension family	1	C		3,4
19.	LPC 2148 architecture, ARM core dataflow model	1	C		3,4
20.	ARM Core extension, overview of instruction set	3	C		3,4
21.	register bank of ARM processor, ARM instruction pipeline	1	C		3,4
22.	memory management	1	C		3,4
23.	Bus architecture (AMBA Bus)	1	C		3,4
24.	interrupt structure, operating modes, Exception Handling	2	C		3,4
25.	ARM-based embedded devices, ARM peripherals	1	C		3,4
26.	other ARM7 features: timer, ADC, DAC, RTC, WDT, PWM etc.	2	C		2
	UNIT IV : Communication Protocols	6			
27.	Concept of protocols. Study of serial and parallel communication protocols – UART, SPI,	2	C		1,5
28.	SCI , I2C, CAN, USB, PCI, Ethernet	2	C		1,2,5
29.	Study of wireless protocols - IrDA, Bluetooth, IEEE802.11,	1	C		1

30.	Zigbee, RF modules, GSM modem for AT command study.	1	C		1
	UNITV : Basics of Real-Time Operating System	9			
31.	Need of RTOS in Embedded system software, RTOS services in contrast with computer OS. Features of μ COS II.	2	C		5
32.	Foreground/Background systems, Kernel architecture,	1	C		5
33.	Task, Task scheduler, context switching.	1	C		5
34.	Scheduling algorithms – First come first serve, Round Robin, Round Robin with Priority, Shortest job first.	1	C		5
35.	Multitasking, Interrupt service routine (ISR),	1	C		5
36.	Semaphores, Mutexes, Events	1	C		5,6
37.	Inter process communication (IPC) - mailbox, message queues,	1	C		5
38.	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 μ C/OS-II on ARM Cortex M3.	1	I-O		3,4,5

11.	Study of scheduling algorithms using μ C/OS-II on ARM Cortex M3.	1	I-O		3,4,5
12.	Study of semaphore and mutex using μ C/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.Slossetal., “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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	NIL						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	MJ						
<i>Course designed by</i>	Department of ECE						
<i>Approval</i>							

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)	2	D-I-O		2,4

	Introduction.				
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.	Timing 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 (SiO ₂).	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", Addison Wesley, 1997.
3.	N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 1993.
4.	Bob 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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	NIL						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	MJ	Major	Engineering				
<i>Course designed by</i>	Department of ECE						
<i>Approval</i>							

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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	NIL						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	MJ						
<i>Course designed by</i>	Department of ECE						
<i>Approval</i>	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 fundamentals 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
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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. Ordnung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.
3.	Foundations for Microwave Engineering — R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 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
<i>Co-requisite:</i>	Microwave Theory and Applications Lab (ECE 321)				
<i>Prerequisite:</i>	NIL				
<i>Data Book/ Codes/Standards</i>	NIL				
<i>Course Category</i>	(MJ) Major				
<i>Course designed by</i>	Department of Electronics and Communication Engineering				
<i>Approval</i>	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 operation 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, 2 nd Edition, 2007.
2	David M Pozar, "Microwave Engineering", Wiley, 4 th Edition, 2004.
3	S.Y. Liao, "Microwave Devices and Circuits", Pearson, 4 th 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
<i>Co-requisite:</i>					
<i>Prerequisite:</i>					
<i>Data Book / Codes/Standards</i>					
<i>Course Category</i>					
<i>Course designed by</i>	DEPARTMENT OF				
<i>Approval</i>	-- 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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	1. Power Electronics 2. Power Systems 3. Control Systems						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	P	Core					
<i>Course designed by</i>	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING						
<i>Approval</i>							

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 and V.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
<i>Co-requisite:</i>	NIL						
<i>Prerequisite:</i>	NIL						
<i>Data Book / Codes/Standards</i>	NIL						
<i>Course Category</i>	P						
<i>Course designed by</i>	DEPARTMENT OF EEE						
<i>Approval</i>	-- 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, transducer, 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, Mark F. McGranaghan McGraw 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								
f)	Get an overview of pulse power systems including energy storage devices, voltage multiplier circuits							
g)	Understand the insulation aspects of pulse power systems							
h)	Understand the different types of high-power switches							
i)	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 1 st 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
<i>Co-requisite:</i>							
<i>Prerequisite:</i>							
<i>Data Book / Codes/Standards</i>							
<i>Course Category</i>	P						
<i>Course designed by</i>	DEPARTMENT OF EEE						
<i>Approval</i>	-- 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”, 3 rd edition, Prentice Hall, 2002
2.	M. Vidyasagar, “Nonlinear Systems”, 2 nd edition, SIAM, 2002.
3.	A. Isidori, “Nonlinear Control System”, 3 rd 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 :						

