KLE Technological University
Creating Value, Leveraging Knowledge

Curriculum Structure and Curriculum Content for the Academic Batch - 2022-26
Department : Electrical & Electronics Engineering
Program: Bachelor of Engineering

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Vision and Mission of KLE Technological University

Vision

KLE Technological University will be a national leader in Higher Education–recognised globally for innovative culture, outstanding student experience, research excellence and social impact.

Mission

KLE Technological University is dedicated to teaching that meets highest standards of excellence, generation and application of new knowledge through research and creative endeavors.

The three-fold mission of the University is:

- To offer undergraduate and post-graduate programs with engaged and experiential learning environment enriched by high quality instruction that prepares students to succeed in their lives and professional careers.

- To enable and grow disciplinary and inter-disciplinary areas of research that build on present strengths and future opportunities aligning with areas of national strategic importance and priority.

- To actively engage in the Socio-economic development of the region by contributing our expertise, experience and leadership, to enhance competitiveness and quality of life.

As a unified community of faculty, staff and students, we work together with the spirit of collaboration and partnership to accomplish our mission.

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Vision and Mission Statements of the School / Department

Vision

KLE Tech Electrical & Electronics Engineering school will be well recognized nationally and internationally for excellence in its educational programs, innovative research and impact on the industry and society.

Mission

- To provide a high quality educational experience through innovative curricula, outstanding teaching, and research training that enable the students to become leaders in their chosen field.
- To contribute to advancement of knowledge in both fundamental and applied areas of Electrical and Electronics Engineering and allied fields.
- Provide scholarly and vibrant learning environment that enable staff and students achieve personal and professional growth.
- To collaborate within and beyond the discipline to create solutions that benefit humanity and society.

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Program Educational Objectives/Program Outcomes and Program-Specific Objectives

Program Educational Objectives -PEO's
1. Graduates will demonstrate peer-recognized technical competency to conceive, analyze, design and implement solutions to problems in Electrical and Electronics Engineering field.
2. Graduates will demonstrate leadership and initiative to advance professional and organizational goals with commitment to ethical standards of profession, teamwork and respect for diverse cultural background.
3. Graduates will continue to develop professionally through life-long learning, advanced education, and other creative pursuits in science and technology.
4. Graduates will be committed to creative practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.
Program Outcomes-PO's
PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10: Project Management and Finance:

Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)
Program Specific Objectives -PSO's
PSO1: Apply the knowledge of Generation, Transmission, Distribution of Electric Power and its control.
PSO2: Apply computational methods to design and analyze Electrical / Electronic Systems.

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Curriculum Structure-Overall

2022-26

Semester: 1 to 8 (2022-26 Batch)									Total Program Credits:180
	I	II	III	IV	V	VI	VII	VIII	
Courses Semester wise	Single variable calculus 18EMAB101 (4-1-0)	18EMAB102 Multivariable Calculus (4-1-0)	15EMAB203 Integral Transforms and Statistics(4-0-0) Calculus and Integral Transforms 15EMAB232	15EMAB208 Linear Algebra and Partial differential equations (4-0-0) Vector Calculus and differential equations 15EMAB242	23EHSA303 Arithmetical Thinking & Analytical Reasoning (Audit)	16EHSC301 Professional Aptitude and Logical reasoning. (3-0-0)	24EEEC401 Power System Modeling Operation & Control (2-0-1)	Program Elective 6 (3-0-0)	Industry Internship Training (0-0-6) Industry Internship Project (0-0-11
	22ECHB102 Engineering Chemistry (3-0-0)	22EPHB101 Engineering Physics (3-0-0)	22EHSH201 Corporate Communication (0.5-0-0)	22EHSH202 Problem Solving & Analysis (0.5-0-0)	17EEEC302 Power System Analysis & Stability (3-0-0)	23EHSA304 Industry Readiness & Leadership Skills (Audit)	Program Elective 3 (2-0-1)	Open Elective (3-0-0)	
	C Prog for problem solving 18ECSP101 (0-0-3)	22ECRP101 Engg Exploration (0-0-3)	19EEEC201 Circuit Analysis (4-0-0)	23EEEC202 ARM Processor & Applications (3-0-0)	OS & Embedded Systems 24EEEC301 (3-0-1)	24EEEC304 Automotive Electronics (2-0-1)	Program Elective 4 (3-0-0)	21EEEW402 Capstone Project (0-0-11)	
	Engg Mechanics 15ECVF101 (4-0-0)	18EECF101 Basic Electronics (4-0-0)	23EEEC201 Analog Electronics Circuits (4-0-0)	17EEEC204 Linear Control Systems (3-0-0)	24EEEC301 Electric Drives & Control (2-0-1)	23EEEC304 CMOS VLSI Circuits (3-0-0)	Program Elective 5 (3-0-0)		
	Basic Electrical Engg 18EEEF101 (3-0-0)	22EMEF101 Basic Mechanical Engg (2-1-0)	19EEEC202 Electrical Power Generation, Transmission & Distribution (3-0-0)	19EEEC204 Electrical Machines (4-0-0)	18EEEC301 Linear Integrated Circuits (3-0-0)	23EEEP304 CMOS VLSI Lab (0-0-1)	15EHSA401 Constitution of India, Professional Ethics and Environmental Studies (Audit)		
	15EHSH101 Professional communication (1-1-0)	21EPHP101 Applied physics lab (0-0-1)	19EEEC203 Digital Circuits (4-0-0)	19EEEC205 Signals & Systems (3-0-0)	24EEEC302 Machine Learning/Deep Learning (2-0-2)	Program Elective 1 (3-0-0)	20EEEP401 Relay and High Voltage Engineering lab (0-0-1)		
	20EHSP101 Design Thinking for Social innovation	18ECSP102 Problem Solving with Data Structures	23EEEP201 Analog Electronics Lab (0-0-1)	20EEEC201 Power Electronics (3-0-0)	20EEEC301 Digital Signal Processing (3-0-0)	Program Elective 2 (3-0-0)	21EEEW401 Senior Design Project (0-0-6)		

	(0-1-1)	(0-0-3)							
			15EEEP203 Digital Circuits Lab (0-0-1)	23EEEP202 ARM Microcontroller Lab (0-0-1)	19EEEP301 Machines Lab (0-0-1)	Generative-AI (24EEEC305) (2-0-1)			
			23EEEF201 Microcontroller Architecture & Programming (2-0-1) 18EEEF201 C Programming (0-0-2) (Dip)	18EEEP203 Digital System Design using Verilog (0-0-2)	23EEEP302 Data acquisition and controls Lab (0-0-1)	24EEEW301 Minor Project (0-0-6)			
				23EEEF202 Data Structure Applications Lab (0-0-2) 23EEEF203 Data Structure Using C Lab (0-0-3) (Lateral Entry Students)	23EEEW301 Mini project (0-0-3)				
Credits	**22**	**22**	**24.5**	**25.5**	**25**	**25**	**19**	17	

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Curriculum Structure-Semester wise

Semester - I

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	18EMAB101	Single Variable Calculus	BS	4-1-0	5	6	50	50	100	3 hours
2	22ECHB102	Engineering Chemistry	BS	3-0-0	3	3	50	50	100	3 hours
3	15ECVF101	Engineering Mechanics	ES	4-0-0	4	4	50	50	100	3 hours
4	18ECSP101	C Programming for Problem solving	ES	0-0-3	3	6	80	20	100	3 hours
5	18EEEF101	Basic Electrical Engineering	ES	3-0-0	3	3	50	50	100	3 hours
6	20EHSP101	Design Thinking for Social Innovation	HSS	0-1-1	2	4	80	20	100	3 hours
7	15EHSH101	Professional Communication	HSS	1-1-0	2	3	50	50	100	3 hours
			Total	15-3-4	22	29				

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Semester - II

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	18EMAB102	Multivariable Calculus	BS	4-1-0	5	6	50	50	100	3 hours
2	22EPHB101	Engineering Physics	BS	3-0-0	3	3	50	50	100	3 hours
3	18ECSP102	Problem Solving with Data Structures	ES	0-0-3	3	6	80	20	100	3 hours
4	22ECRP101	Engineering Exploration	ES	0-0-3	3	6	80	20	100	3 hours
5	18EECF101	Basic Electronics	ES	4-0-0	4	4	50	50	100	3 hours
6	22EMEF101	Basic Mechanical Engineering	ES	2-1-0	3	4	50	50	100	3 hours
7	21EPHP101	Applied Physics Lab	BS	0-0-1	1	2	80	20	100	3 hours
			Total	13-2-7	22	31				

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Semester- III

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	15EMAB203/ 15EMAB232	BS: Integral Transforms and Statistics/ Calculus and Integral Transforms (Lateral Entry Students)	ES	4-0-0	4	4	50	50	100	3 hours
2	22EHSH201	ES1Corporate Communication	ES	0.5-0-0	0.5	4	100	--	100	3 hours
3	19EEEC201	PC1Circuit Analysis	PC	4-0-0	4	4	50	50	100	3 hours
4	23EEEC201	PC2Analog Electronic Circuits	PC	4-0-0	4	4	50	50	100	3 hours
5	19EEEC202	PC3Electrical Power Generation, Transmission & Distribution	PC	3-0-0	3	3	50	50	100	3 hours
6	19EEEC203	PC4Digital Circuits	PC	4-0-0	4	4	50	50	100	3 hours
7	23EEEP201	PCL1Analog Electronics Laboratory	PC	0-0-1	1	2	80	20	100	2 hours
8	15EEEP203	PCL2Digital Circuits Laboratory	PC	0-0-1	1	2	80	20	100	2 hours
9	23EEEF201	PCL3Microcontroller Architecture & Programming	ES	2-0-1	3	4	80	20	100	2 hours
	18EEEF201	C Programming (Dip)	ES	0-0-2	2	4	80	20	100	2 hours
		TOTAL		21.5-0-3	24.5	27				

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Semester- IV

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	15EMAB208 15EMAB242	BS Linear Algebra and Partial differential equations/ Vector Calculus and Integral Transforms (Lateral Entry Students)	BS	4-0-0	4	4	50	50	100	3 hours
2	22EHSH202	ES2Problem Solving & Analysis	ES	0.5-0-0	0.5	1	100	--	100	3 hours
3	23EEEC202	PC5ARM Processor & Applications	PC	3-0-0	3	3	50	50	100	3 hours
4	17EEEC204	PC6Linear Control Systems	PC	3-0-0	3	3	50	50	100	3 hours
5	19EEEC204	PC7Electrical Machines	PC	4-0-0	4	4	50	50	100	3 hours
6	19EEEC205	PC8Signals & Systems	PC	3-0-0	3	3	50	50	100	3 hours
7	20EEEC201	PC9Power Electronics	PC	3-0-0	3	3	50	50	100	3 hours
8	23EEEP202	PCL4ARM Microcontroller Lab	PC	0-0-1	1	2	80	20	100	2 hours
9	18EEEP203	PCL5Digital System Design using Verilog	PC	0-0-2	2	4	80	20	100	2 hours
10	23EEEF202	PCL6Data Structure Applications Lab	ES	0-0-2	2	4	80	20	100	2 hours
	23EEEF203	Data Structure Using C Lab (Lateral Entry Students)		0-0-3	3	6	80	20	100	2 hours
		TOTAL		20.5-0-5	25.5	36				

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Semester- V

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	23EHSA303	ES3Arithmetical Thinking & Analytical Reasoning	ES	0-0-0	Audit	1	100	--	100	3 hours
2	17EEEC302	PC10Power System Analysis & Stability	PC	3-0-0	3	3	50	50	100	3 hours
3	18EEEC301	PC11Linear Integrated Circuits	PC	3-0-0	3	3	50	50	100	3 hours
4	24EEEC301	PC12Electric Drives & Control	PC	2-0-1	3	4	50	50	100	2 hours
5	24EEEC302	PC13Machine Learning & Deep learning	PC	2-0-2	4	6	50	50	100	2 hours
6	24EEEC303	PC14OS & Embedded System Design	PC	3-0-1	4	5	50	50	100	3 hours
7	20EEEC301	PC15Digital Signal Processing	PC	3-0-0	3	3	50	50	100	3 hours
8	19EEEP301	PCL7Machines Lab	PC	0-0-1	1	2	80	20	100	2 hours
9	23EEEP302	PCL8Data acquisition and controls Lab	PC	0-0-1	1	2	80	20	100	2 hours
10	15EMAB302	Linear algebra and statistics (Lateral Entry Students)	ES	3-0-0	3	3	50	50	100	3 hours
11	23EEEW301	P1 Mini project	PW	0-0-3	3	6	50	50	100	2 hours
			TOTAL	16-0-9	25	38				

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Semester- VI

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	16EHSC301	H3Professional Aptitude and Logical reasoning.	HC	3-0-0	3	3	50	50	100	3 hours
2	23EHSA304	ES4Industry Readiness & Leadership Skills	ES	0-0-0	Audit	1	100	--	100	--
3	23EEEC304	PC16CMOS VLSI Circuits	PC	3-0-0	3	3	50	50	100	3 hours
4	24EEEC304	PC17Automotive Electronics	PC	2-0-1	3	4	67	33	100	2 hours
5	XXEEEE3XX	Program Elective 1	PC	3-0-0	3	3	50	50	100	3 hours
6	XXEEEE3XX	Program Elective 2	PC	3-0-0	3	3	50	50	100	3 hours
7	23EEEP304	PCL9CMOS VLSI Circuits Lab	PC	0-0-1	1	2	80	20	100	2 hours
8	24EEEC305	PC18 Generative- AI		2-0-1	3	4	67	33	100	2 hours
9	24EEEW301	Minor Project	PW	0-0-6	6	10	50	50	100	2 hours
			TOTAL	**16-0-9**	**25**	**33**				

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Semester- VII

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	24EEEC401	PC18Power System Modelling Operation & Control	PC	2-0-1	3	4	67	33	100	2 hours
2	XXEEEE4XX	Program Elective 3	PSE	3-0-0	3	3	50	50	100	3 hours
3	XXEEEE4XX	Program Elective 4	PSE	3-0-0	3	3	50	50	100	3 hours
4	XXEEEE4XX	Program Elective 5	PSE	3-0-0	3	3	50	50	100	3 hours
5	15EHSA401	Constitution of India, Professional Ethics and Environmental Studies	HSC	0	0	0	0	0	0	0
6	24EEEP401	Relay and High Voltage Engineering lab	PC	0-0-1	1	2	80	20	100	2 hours
7	21EEEW401	Senior Design Project	PC	0-0-6	6	12	50	50	100	3 hours
			TOTAL	**11-0-8**	**19**	**27**				

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Semester- VIII

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1		Program Elective 6	PC	3-0-0	3	3	50	50	100	3 hours
2		Open Elective	PSE	3-0-0	3	3	50	50	100	3 hours
3	21EEEW402	Capstone Project	PSE	0-0-11	11	22	50	50	100	3 hours
			TOTAL	**6-0-11**	**17**	**28**				
or										
1	18EEEI493	Internship Training	PRJ	0-0-6	6	12	50	50	100	3 hours
2	20EEEW494	Internship Project	PRJ	0-0-11	11	22	50	50	100	3 hours
				6-0-11	**17**	**28**	150	150	300	

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Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	22	22	24.5	25.5	25	25	19	17	180

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List of Program Electives

Sr. No	Name of the Course	Course Code
1.	Electric Vehicular Technology	24EEEE301
2.	Battery Management Systems	25EEEE403
3.	Traction Systems for Electric Vehicles	20EEEE401
4.	Powertrain Control System Design	25EEEE402
5.	Modelling & Analysis of Hybrid Electrical Energy Systems	24EEEE302
6.	Smart Grid Technologies	25EEEE401
7.	Flexible AC Transmission System (FACTS)	19EEEE401
8.	Nonlinear Control Systems	25EEEE409
9.	Modern Control Systems	25EEEE410
10.	Digital Control Systems	25EEEE411
11.	Electricity & Safety Measures	25EEEE412
12.	Switched Mode Power Converters	25EEEE413
13.	Object Oriented Programming using C++	24EEEE305
14.	AUTOSAR	25EEEE404
15.	Architectural Design of Integrated Circuits	24EEEE303
16.	System Verilog using Verification	25EEEE406
17.	CMOS ASIC Design	25EEEE407
18.	Advanced IC Packaging	25EEEE405
19.	Human Machine Interface	25EEEE408
20.	Design for Testability	25EEEE414
21.	System on Chip Design	25EEEE415

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Curriculum Content- Course wise

I Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		Semester: I
Course Title: Single Variable Calculus		Course Code: 18EMAB101
L-T-P: 4-1-0	Credits: 05	Contact Hours: 5 Hrs/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 50	Examination Duration: 3Hrs	

Unit I	
Chapter No. 1 Functions, Graphs and Models Functions, types of functions, transformations and models (Linear, exponential, trigonometric). MATLAB: Graphing functions, Domain-Range and Interpreting the models	07 Hrs
Chapter No. 2 Calculus of functions and models Limit of a function, Infinite limits- graph, Continuity and discontinuity, Intermediate value theorem statement, Roots of the equation using Bisection Method and Newton- Raphson Method Interpretation of derivative as a rate of change, All the rules of derivatives (List only), Maxima, Minima and optimization problems. Curvature and Radius of Curvature, Indeterminate forms, L- Hospital's rule-Examples MATLAB: Optimization problems. Curvature problems	13 Hrs
Unit II	
Chapter No. 3 Infinite Series Definition, Convergence of series, Tests of convergence – p-series, Alternating series. Power series, radius of convergence, Taylor's and Maclaurin's series, Applications of Taylor's and Maclaurin's series MATLAB: Convergence of series	06 Hrs
Chapter No. 4 Integral calculus Tracing of standard curves in Cartesian form ,Parametric form and Polar form; Beta and gamma function, relation between them, evaluation of integrals using Beta and gamma functions; Applications to find arc length, Area, Volume and Surface area (Cartesian, parametric and polar curves). Approximate integration-Trapezoidal rule, Simpson's 1/3 rule MATLAB: problems on arc length, area, volume and surface area	14 Hrs
Unit III	
Chapter No. 5 Ordinary differential equations of first order (a) Introduction to Initial Value problems. Linear and Bernoulli's equations, Exact equations and reducible to exact form, Numerical solution to Initial Value problems-Euler's method, Modified Euler's method and Runge-Kutta method (b) Applications of first order differential equations-Orthogonal trajectories growth and decay problems, mixture problems, Electrical circuits, falling bodies. MATLAB: Solve differential equations.	10 Hrs

Text Books 1. Early Transcendentals Calculus- James Stewart, Thomson Books, 7ed 2010.	
Reference Books: 1. Calculus Single and Multivariable, Hughues-Hallett Gleason, Wiley India Ed, 4ed, 2009. 2.Thomas Calculus, George B Thomas, Pearson India, 12ed, 2010	

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Program: Electrical & Electronics Engineering		Semester: I
Course Title: Engineering Mechanics		Course Code: 15ECVF101
L-T-P: 4-0-0	Credits:4	Contact Hrs: 4 Hrs/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 50	Exam Duration: 3 hours	

Unit I	
Chapter No. 1: Overview of Civil Engineering Evolution of Civil Engineering Specialization, scope and role. Impact of Civil Engineering on National economy, environment and social & cultural fabric. Challenges and Opportunities for Civil Engineers Civil Engineering Marvels, Future challenges, Higher education and Research.	04 Hrs
Chapter No. 2: Coplanar concurrent force system : Introduction to Engineering Mechanics: Basic idealizations – Particle, Continuum, Body, Rigid body, Deformable body, Definition of force and its elements; Laws of Mechanics – Parallelogram law of forces, Principle of transmissibility, Law of Superposition, Newton's laws of motion. Classification of force systems. Resultant of coplanar concurrent force system: Definitions – Resultant, composition & Resolution of a force, Equilibrium, Equilibrant, Formulae for resultant of forces and resolution of a force. Numerical problems on resultant of forces. Equilibrium of coplanar concurrent force system: Conditions of equilibrium, Action & Reaction, Free body diagram, Lamis' theorem. Numerical problems on equilibrium of forces.	12 Hrs
Chapter No. 3: Coplanar non-concurrent force system : Resultant of a force system: Moment, moment of a force, couple, moment of a couple, Characteristics of couple, Equivalent force-couple system, Numerical problems on moment of forces and couples, on equivalent force-couple system. Varignon's principle of moments, Resultant of coplanar- non-concurrent force systems and numerical problems.	05 Hrs
Unit II	
Chapter No. 4: Equilibrium of a force system (Chapter 3 contd..) Conditions of equilibrium, types of support and loading for a statically determinate beam, Reactions at support connections, Numerical problems on equilibrium of force systems and support reactions for a statically determinate beam. 05 Hrs	19 Hrs
Chapter No. 5: Static Friction Introduction, types of friction, definition, limiting friction, coefficient of friction, laws of Coulomb friction, angle of friction and angle of repose, cone of friction. Wedge and belt friction theory. Derivation of belt friction formula. Numerical problems on, impending motion on horizontal and inclined planes (including connected bodies); wedge friction; Ladder friction and Belt friction. **08 Hrs**	
Chapter No. 6: Simple Stress and Strain Introduction, Properties of Materials, Stress, Strain, Elasticity, Elastic limit, Hooke's law & Young's modulus, Stress – Strain Diagram for structural steel, working stress and Factor of safety. Deformation of a bar due to force acting on it. Law of super position. Stresses in bars of uniform & varying cross sections. Composite sections. Problems connected to above topics. 06 Hrs	
Unit – III	

Chapter No. 7: Centroid of Plane Figures Introduction, Definition, Methods of determining the centroid, axis of reference, axis of symmetry, Locating the centroid of simple plane figures (triangle, semicircle, quarter of a circle and sector of a circle etc,.) using method of integration, Numerical problems on Centroid of simple built up sections. 05 Hrs	10 Hrs
Chapter No. 8: Second moment of area (Plane figures) Introduction, Definition, Method of determining the second moment of area, Section Modulus, Radius of gyration, perpendicular and Parallel axis theorems, Polar second moment of area, second moment of area of simple plane figures (triangle, rectangle, semicircle, circle etc,.) using method of integration, Numerical problems on MI of simple built up sections. 05 Hrs	

Text Books:

1.Beer, F.P. and Johnston, R., Mechanics for Engineers: Statics, McGraw Hill Company, New York, 1988.
2. Bhavikatti, S.S., and Rajashekarappa K.G., Engineering Mechanics, 3rd ed., New Age International Pub. Pvt. Ltd., New Delhi, 2008.
3. Kumar, K.L., Engineering Mechanics, 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2003.
4. Punmia, B.C., Jain, A., Mechanics of Materials, Lakshmi Publications, New Delhi, 2006

Reference Books:

1. Jagadeesh, T.R. and Jayaram, Elements of Civil Engineering, Sapna Book House, Bangalore, 2006.
2. Ramamrutham, S., Engineering Mechanics, Dhanpat Rai Publishing Co., New Delhi, 1998.
3. Singer, F.L., Engineering Mechanics, 3rd edition Harper Collins, 1994.
4. Timoshenko, S.P. and Young, D.H., Engineering Mechanics, 4th edition, McGraw Hill Publishing Company, New Delhi, 1956.
1. Irving H Shames, Engineering Mechanics, 3rd edition, Prentice-Hall of India Pvt. Ltd, New Delhi- 110 001, 1995.

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Program: Electrical & Electronics Engineering		Semester : I
Course Title: Engineering Chemistry		Course Code: 22ECHB102
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 Hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40	Examination Duration: 3 Hrs	

Unit I	
Chapter No. 1 Chemical Bonding and Molecular Structure Chemical bonding – Types, Ionic bond: Formation of NaCl molecule, factors influencing the formation of ionic bond – ionization energy, electron affinity and lattice energy, Born–Haber's cycle, calculation of lattice energy of NaCl molecule and properties of ionic compounds; Covalent bond: atomic orbital theory – formation of H_2 molecule, polar and nonpolar covalent bonds – H_2 and HCl molecules, dipole moment, calculation of percentage of ionic character and properties of covalent compounds. Hybridization: sp, sp^2 and sp^3 hybridization - geometry of BeF_2, BF_3 and CH_4 molecules. VSEPR Theory: regular and irregular geometry, geometry of $SnCl_2$, NH_3 and H_2O molecules.	06 Hrs
Chapter No. 2 Electrochemical Energy Systems Electrode potential, Nernst equation; Formation of a cell; Reference electrodes: Calomel electrode - determination of electrode potential; Numerical problems on E, Ecell and E0cell. Batteries: classification, characteristics, Lead - acid battery and Lithium ion battery. Fuel cells: Types of fuel cells; Methanol - Oxygen fuel cell.	06 Hrs
Chapter No. 3 Polymer Chemistry Polymers, properties, classification, free radical mechanism of addition polymerization by taking ethylene as an example. Commercial polymers: plexi glass and polyurethane. Polymer composites: carbon fibre and epoxy resin – synthesis, properties and applications. Conducting polymers: Polyaniline – synthesis, mechanism of conduction in doped polyaniline and its applications.	04 Hrs
Unit II	
Chapter No. 3 Plating Techniques Technological importance of plating techniques, Types of plating, Electroplating: Definition, electroplating of Gold by acid cyanide bath, determination of Throwing Power of plating bath by Haring Blum cell and numerical problems. Electroless plating: advantages of electroless plating over electroplating, electroless plating of Copper and its application in the manufacture of printed circuit board (PCB).	03 Hrs
Chapter No. 4 Wafer Technology Introduction, physical and chemical properties of silicon, metallurgical grade silicon, purification of silicon; chemical vapor deposition (CVD) process, zone refining process. Crystal growth: preparation of single crystal silicon by Czhochralski crystal pulling technique and numerical problems. Crystal slicing and wafer preparation; Fabrication process: thermal oxidation, diffusion, ion implantation, numerical problems, epitaxial growth, masking, photolithography; wet etching and dry etching.	10 Hrs
Chapter No. 5 Material Chemistry	03 Hrs

Liquid crystals: classification of liquid crystals, applications of liquid crystals in display systems. Glass: properties, smart glass: electrochromic, thermochromic and photochromic smart glass - properties and applications. Thermoelectric and Piezoelectric materials - meaning, properties and applications.	
Unit III	
Chapter No. 6 Water Chemistry Water: sources, impurities in water, potable water: meaning and specifications (as per WHO standards). Hardness: determination of total hardness of water by EDTA method and numerical problems. Purification of water: Flash distillation, Reverse Osmosis, Electrodialysis - principle, process and applications.	04 Hrs
Chapter No. 7 Instrumental Methods of Measurement Advantages over conventional methods. Electro analytical methods: Potentiometer - principle, methodology and applications. Optoanalytical methods: Colorimeter - Principle, methodology and applications. Spectral methods of analysis: UV Spectrophotometer - Instrumentation and applications.	04 Hrs

Text Books:

1. A text Book of Engineering Chemistry, 1st edition, Dara. S. S, S. Chand and Co. Ltd., 2009, New Delhi.
2. A text Book of Engineering Chemistry, 16th edition, Jain P.C and Jain M, Dhanpat Rai Publications, 2006, New Delhi.
3. Engineering Chemistry, 3rd Edition, Krishnamurthy. N., Vallinayaga. P. and Madhavan. D., PHI/E- Books Premium, 2014.

Reference Books:

1. **1.** Text book of Inorganic Chemistry, P. L. Soni, Sultan Chand, 1999, New Delhi.
2. Inorganic chemistry: Principles of structure and reactivity, , 4th Edition, James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd., 2006, New Delhi.
3. 2. Concise Inorganic Chemistry ELBS, 5th Edition, J.D. Lee, Wiley, 2008, New York.
4. Hand book of batteries, 3rd edition, David Linden, Thomas B Reddy, McGraw Hill publications, 2001, New York.
5. 3. Polymer Science, 6th edition, Gowariker V.R, Viswanatan N.V, Sreedhar J., New Age International (P) ltd., 2007, New Delhi.
6. 4. Text Book of Polymer Science, 3rd edition, Fred W. Billmeyer, John Wiley and Son's, 1984, New York.
7. 5.VLSI Technology, 2nd Edition, S. M. Sze, McGraw-Hill Series in Electrical and Computer Engineering, 1998, New York.
8. 6. Solid State Devices & Technology, 4th Edition, V. Suresh Babu, Sanguine Technical Publishers, 2005, Bangalore.
9. 7. Materials Science and Engineering: An introduction, 9th Edition, Callister William D, John Wiley and Sons, 2007, New York.
10. 8. Instrumental Methods of Chemical Analysis, 5th edition, Gurdeep R Chatwal, Sham K Anand, Himalaya Publishing House, Pvt. Ltd, 2010, Mumbai.

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Program: Electrical & Electronics Engineering		Semester: I
Course Title: Basic Electrical Engineering		Course Code: 18EEEF101
L-T-P: 3-0-0	Credits: 3	Contact Hours: 3 Hrs/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours : 40 Hrs	Exam Duration: 3 Hrs.	

Unit I	
Chapter No. 1 Overview of Electrical Engineering Specialization, scope & role, impact of Electrical Engineering on national economy, environment, Sources of generation, sustainability, challenges and opportunities for electrical engineers, electrical engineering marvels, future challenges.	02 Hrs
Chapter No. 2 DC Circuits Voltage and current sources, Kirchoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Time-domain analysis of first-order RL and RC circuits.	05 Hrs
Chapter No. 3 AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. power measurement using two watt meters	08 Hrs
Unit-II	
Chapter No. 4 Electrical Actuators Electromagnetic principles, Solenoid, Relays, classification of Electric motors, DC motors-shunt, series, compound, separately excited, PMDC motors – Speed Control, Stepper Motors, BLDC motors, three phase induction motor, Characteristics and applications, selection of motors for various applications.	09 Hrs
Chapter No. 5 Power Electronics (Text1, chapter 45) Introductory, Thyristor, Some thyristor circuits, Limitations to thyristor operation, The thyristor in practice, The fully controlled AC/DC converter, AC/DC inversion, Switching devices in inverters, Three-phase rectifier networks, The three-phase fully controlled converter, Inverter-fed induction motors, Soft-starting induction motors, DC to DC conversion switched-mode power	06 Hrs
Unit-III	
Chapter No. 6 Electrical Wiring, Safety and protection(Ref :Text3-page 1 to 10) Types of wires and cables for internal wiring, Types of switches and Circuits, Types of wiring, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Importance of grounding and earthing, Methods for earthing, Fuses, MCB, ELCB and Relays, Lockout and Tagout, Electrical Codes and Standards.	05 Hrs
Chapter No. 7 Batteries: Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing. Numericals.	05 Hrs
Text Books: **1.**Hughes Electrical & Electronics Engineering, Electrical & Electronic Technology, 8th , Pearson Education, 2001	

2.P C Sen, Principals of Electrical Machines and Power Electronics, 2nd, Wiley Publications
3.Gilbert M Masters, Renewable and efficient Electrical Power systems, Published by John Wiley & Sons, 2004 edition
4.Frank D. Petruzella, Electric Motors and Control Systems, McGraw Hill Education Private Limited, 2009 Edition

Reference Books:

1.D. C. Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications
2.David G. Alciatore and Michel B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005
3.Vincent Del Toro, Electrical Engineering Fundamentals, 2nd edition, Prentice Hall India

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KLE Technological University | Creating Value, Leveraging Knowledge

Program: Electrical & Electronics Engineering		Semester: I
Course Title: Professional Communication		**Code: 15EHSH101**
L-T-P: 1-1-0	**Credits: 2**	**Contact Hrs.: 02Hrs/week**
ESA Marks: 50	**ISA Marks: 50**	**Total Marks: 100**
Teaching Hrs.: 42		**Exam Duration: 3 Hrs.**

Content	
Chapter No. 1. Basics- English Communication Course Introduction, Explanation of template mix-ups with correct usages & necessity of grammar in error detection, Usage of tenses	09 Hrs
Chapter No. 2. Vocabulary and grammar Vocabulary, Word Formation and Active and Passive Voice	06 Hrs
Chapter No. 3. Bouncing Practice Definition and types of bouncing and its practice with examples, reading skills, free style speech. Individual presentation.	06 Hrs
Chapter No. 4. Rephrasing and Structures Comprehension and Rephrasing, PNQ Paradigm and Structural practice	08 Hrs
Chapter No. 5. Dialogues Introduction of dialogues, Situational Role plays	03 Hrs
Chapter No. 6. Business Communication Covering letter, formal letters, Construction of paragraphs on any given general topic.	09 Hrs

Reference Books:

1. Collins Cobuild Advanced Learner's English Dictionary
2. Raymond Murphy - Intermediate English Grammar, Cambridge University Press
3. Martin Hewings- Advanced English Grammar, Cambridge University Press.

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Program: Electrical & Electronics Engineering				Semester: I
Course Title: Design Thinking for Social Innovation				Course Code: 20EHSP101
L-T-P : 0-1-1			Credits: 2	Contact Hrs.: 2Hrs/week
ESA Marks: 80			ISA Marks: 20	Total Marks: 100
Teaching Hours : 28			Exam Duration: 3 Hrs.	
		Topics	Assignments	Support activities / Tools
KNOWLEDGE, TOOLS & DEVELOPMENT	Course sensitization	1. Introduction to Social Innovation: • Awakening social consciousness (www.yourstory.com) • Social Innovation and Leadership • Engineering& Social innovation (EPICS) (Connecting SI Course to Mini Project, Capstone Project, Campus Placements) • Course Overview • Students' Self Introduction Activity • Group formation Activity	**Reading assignments** • Read the handout on "The Process of Social Innovation" by Geoff Mulgan • Design thinking for Social Innovation **Written Assignments** • Writing about Akshaya Patra in class. (Background information about Akshaya patra and the Social Cuase it is addressing) • Brainstorming Session on Social Innovators in Class	• Class activity on Behavioral Blocks to Innovation Discussion on the behavioural blocks. • Introducing oneself with three Adjectives- Appreciating diversity and discovering self • Group Formation Activity (Forming square) (Making four equilateral triangles out of popsicle sticks to enhance group cohesiveness amongst the group-mates)
	Create Mindsets	**Seven Mindsets:** 1. Empathy (Example of The Boy and the Puppies) 2. Optimism (Person Paralyzed waist down / Glass Half full, Half Empty) 3. Iteration (Thomas Alva Edison) 4. Creative Confidence (Origamy – Josef Albers) 5. Making it 6. Embracing Ambiguity	**Reading assignments** • Handout on "Create Mindsets"	• (How to train the Dragon? Common Video for all the mindsets) • Watching in Class TED Talk on "How to build your Creative Confidence by David Kelley – IDEO Founder)

		(Confusion is the Welcome doormat at the door of Creativity) 7. Learning from Failure (Designing Website first and then asking the stakeholders about the website) (Spending one lakh for the business which is never launched)		
	Process of Social Innovation	**Engage** Community study and Issue Identification	**Reading assignments** • Handout on Community Study and Issue Identification • Case Study on "E-GramSeva" • Case Study on "Janani Agri Serve" **Class Presentations** • Initial observations being made by the group **(Literature Survey of Places of Hubli-Dharwad) www.readwhere.com** • Detailed interaction / engagements with the society and finalize the social issue for intervention **Use template 1: Frame your Design Challenge**	• Activity on Observation skills To know how to use one's observation skills in understanding the social conditions • Experience sharing by senior students • Brainstorming Deliberations on the initial observations and arrive at the "Social Issue" • Familiarization of the respective templates with the help of sample case study
		PEER REVIEW		
		2. Inspiration • Plan for the Research • Development of Interview guide • Capture your Learnings	**Reading assignments** • Handout on Overview of Inspiration **Class Presentations** • Entirety of the Social Issue • Identification of the Stake Holders **(Examples on Fluorescent Curtain and Students' Punctuality for Class)** • Interview Questions	• Familiarization of the respective templates with the help of sample case study

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			(Role Play on Interview with Stakeholders) • Category wise Learnings capture **Use template 2: Plan your Research** **Template 3. Development of Interview Guide** **Template 4. Capture your Learning**	
		3. Ideation **3.1 Synthesis** • Search for meaning • Create "How might we" question	**Reading assignments** • Handout on Overview of Ideation-Synthesis **Class Presentations** • Create insights • "How might we" questions **Use template 5:Create Insights** **Template 6: Create "How Might We' Questions**	• Familiarization of the respective templates with the help of sample case study
		3.0 Ideation **3.2 Prototyping** • Generate Ideas • Select Promising Ideas • Determine what to prototype • Make your prototype • Test and get feedback	**Reading assignments** • Handout on Overview of Ideation-Prototyping **Class Presentations** • Story board-demonstrating the possible solutions **Use template 7: Select your best ideas** **Template 8 : Determine what to prototype**	• Brain storming • Familiarization of the respective templates with the help of sample case study • Activity on Risk management • Activity on Resource management Structure building games
		PEER REVIEW		
		4.0 Implementation • Create an action plan • Community Partners (if any) • Budgeting & Fundraising 1. Peer to Peer 2. Crowd Funding 3. Giving Kiosks 4. Donation 5. Envelop Funding	**Reading assignments** • Handout on Overview of Implementation **Class Presentations** • Pilot implementation plan with required resources and Budget indicating stake holders & their engagement	• Familiarization of the respective templates with the help of sample case study

		6. Marathons/ Walkathons 7. Conducting Yoga Classes (www.causevox.com / www.blog.fundly.com) • Duration • Ethical concerns • Launch your solution • Feedback (Impact)		
		5.0 Reflect Reflection of the overall learning by the students	**Reading assignments** • Handout on Overview of students reflection **Use template 9: Reflection on the Process** **Class Presentations** Final Presentation- After Implementation	• Familiarization of the respective templates with the help of sample case study

Program: Electrical & Electronics Engineering		Semester: I
Course Title: C Programming for Problem solving		Course Code: 18ECSP101
L-T-P: 0-0-3	Credits: 3	Contact : 6 Hrs./week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching : 78 Hrs.	Exam Duration: 3 Hrs.	

Unit I	
Chapter No. 1 Introduction to Problem solving Introduction to algorithms / flowcharts and its notations, top down design, elementary problems.	03 Hrs
Chapter No. 2 Basics of C programming language Characteristics and uses of C, Structure of C program, C Tokens: Keywords, Identifiers, Variables, Constants, Operators, Data-types, Input and Output statements.	15 Hrs
Chapter No. 3 Decision control statements Conditional branching statements: if statement, if else statement, else if ladder, switch statement, unconditional branching statements: break, continue. Introduction to Debugging Skills Introduction to Test Driven Programming.	12 Hrs
Chapter No. 4 Iterative statements while, do-while, for, nested statements	10 Hrs
Chapter No. 5 Functions Introduction, Function declaration, definition, call, returns statement, passing parameters to functions, introduction to macros. Introduction to Coding Standards	10 Hrs
Chapter No. 6 Arrays and Strings Introduction, Declaration, Accessing elements, Storing values in arrays, Operations on one dimensional array, Operations on two dimensional arrays, Introduction to Code Optimization and refactoring	15 Hrs
Chapter No.7 Pointers Introduction, declaring pointer, pointer variables, pointer expression and arithmetic, passing arguments to functions using pointers, pointers and arrays, passing an array to a function.	08 Hrs
Chapter No. 8 Structures and Unions Introduction, passing structures to functions, Array of structures, Unions	05 Hrs
Text Books: 1. R.G.Dromey, How to Solve it by Computer, 1ed, PHI, 2008. 2. Yashvant Kanetkar, Let us C ,15th ed, BPS Publication, 2016.	
Reference Books: **1.** B W Kernighan, D M Ritchie, The Programming language C, 2ed, PHI, 2004. 2. B S Gottfried, Programming with C, 2ed, TMH, 2006. 3. B.A. Forouzan, R.F. Gilberg, A Structured Program Approach Using C, 3ed, CENGAGE Learning, 2008.	

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II Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Semester: II**
Course Title: Basic Mechanical Engineering		**Course Code: 22EMEF101**
L-T-P: 2-1-0	**Credits: 3**	**Contact Hrs: 4 Hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40	**Examination Duration: 3 Hrs**	
Unit I		
Chapter No. 1 Introduction to Mechanical Engineering: Mechanical Engineering, Mechanical Engineers' top ten achievements, Branches of Mechanical Engineering, Mechanical product Example: Pressure Cooker.		02 Hrs
Chapter No. 2 Power Transmission Drives: Overview Design Application: • Belt Drives (Flat belt), Length of Belt. Velocity Ratio, Initial Tension. Ratio of Tensions. Power Transmitted, Numerical Problems. • Gears. Spur Gear, Rack and Pinion, Worm Gear, Bevel Gear, Helical Gears and Elliptical gear. Speed, Torque, and Power in Gear pair. Simple and Compound Gear trains. Numerical Problems. Hydraulic transmission system.		06 Hrs
Unit II		
Chapter No. 3 Manufacturing Engineering: What is manufacturing? Classification of Manufacturing Processes, Metal joining processes- Soldering, brazing, and welding (Arc and gas welding). Machine tools- Lathe, Milling, Drilling Grinding (working principle and operations). CNC machines, Robotics and its applications. Additive manufacturing techniques.		06 Hrs
Chapter No. 4 IC engines and Electric powertrains: Internal Combustion Engines: Classification, IC engine parts, 4 Stroke SI and CI Engine, Comparison of 2stroke and 4 stroke engine, comparison of CI and SI engine, Problems on Engine Performance. Electric drives. Hybrid drives- series and parallel layout.		04 Hrs
Unit III		
Chapter No. 5 Refrigeration and Air conditioning: Refrigeration system, vapour compression refrigeration system, vapour absorption system, refrigerants and their properties. Air conditioning system. Solar passive gains: Direct gain, Indirect gain, Isolated gain. Solar passive cooling methods: Direct evaporative cooling, Indirect cooling systems.		03 Hrs
Chapter No. 6 Fluid movers: Pumps, Blowers and Compressors and their working principle		03Hrs
Tutorial Content		
Virtual Prototyping: 2D sketching, 3D modelling-Extrude, Revolve, Pattern and Sheet Metal Assembly.		08 Hrs
• Visit to workshop: welding shop, sheet metal shop, machine Shop. • Demonstration of various machine tools such as lathe, milling, drilling and grinding machines and safety precautions in workshop.		08 Hrs

• Assembly and disassembly of bicycle and demonstration on welding (electric arc welding, gas welding). Demonstration and exercise on sheet metal work.	

Text Books:

1. Jonathan Wickert and Kemper Lewis, An Introduction to Mechanical Engineering, Third Edition, Cengage Learning, 2013
2. K.R. Gopalkrishna, Sudhir Gopalkrishna, S.C. Sharma, A Text Book of Elements of Mechanical Engineering, 30th Edition, Subhash Publishers, Bangalore, 2010
3. Dr. N. Krishnamurthy, Dr. H. S. Manohar, Mr. Sagar M. Baligidad, Elements of Mechanical Engineering, First Edition, Sunstar Publisher, 2014

Reference Books:

1. SKH Chowdhary, AKH Chowdhary, Nirjhar Roy, The Elements of Workshop Technology, Vol I & II, 11th edition, Media Promoters and Publishers, 2001
2. Roger Timings, Basic Manufacturing, Third edition, Newnes, An imprint of Elsevier, 2010

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Program: Electrical & Electronics Engineering		Semester: II
Course Title: Engineering Physics		Course Code: 22EPHB101
L-T-P: 3-0-0	Credits: 03	Contact Hrs: 3 Hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40	Examination Duration: 3 Hrs	

Unit I	
Chapter No. 1 CONDUCTION IN SOLIDS Conduction in metals: Review of classical free electron theory: drift velocity, electrical conductivity, mobility and temperature effect on conductivity, resistivity, failure. Quantum free electron theory, bands theory of solids, classification of materials based on energy bands and bonding force between atoms. Fermi energy, fermi level, fermi factor, density of states (qualitative). Semiconductors: Introduction, technological importance and applications. Intrinsic semiconductors: Energy bands structure in semiconductors, fermi level, fermi factor, density of states, carrier concentration in intrinsic semiconductors. Electron motion and hole transfer, drift current, diffusion current, mobility and conductivity. Extrinsic Semiconductors: n-type and p-type semiconductors: structure, band diagram with fermi level, conductivity, charge neutrality condition, law of mass action, majority and minority charge carriers, effects of heat and light, Hall effect, numericals.	11 Hrs
Chapter No. 2 PN-JUNCTION The PN-Junctions: Junction of p-type and n-type, barrier voltage, depletion region, qualitative theory of p-n Junction. Biased junctions: Reverse biased junction, forward biased junction, junction temperature effects. Junction currents and voltages: Shockley equation, junction currents, junction voltages. PN-junction diode characteristics and parameters: Forward and reverse characteristics (Ge and Si), diode parameters. Temperature Effects: Diode power dissipation, forward voltage drop, dynamic resistance. Diode specifications: Diode data sheets. Diode testing: use of ohmmeter and digital multimeter. Zener diodes: Junction break down mechanism, circuit symbols, characteristics and parameters, numericals.	05 Hrs
Unit II	

Chapter No. 3 ELECTROSTATICS Review of vectors: Co-ordinate systems, vector and scalar quantities, properties of vectors, components of a vector and unit vectors. Vector operations: gradient, divergence and curl. Vector integrals, Gradient, Green's and Stokes theorem. Electric Fields: Properties of electric charges, charging objects by induction, Coulomb's law, Analysis Model: Particle in a electric field, electric field of a continuous charge distribution, electric field lines motion of a charged particle in a uniform electric field, Gauss's Law: Electric flux, Gauss's law, application of Gauss's law to various charge distributions. Dielectrics and Capacitors: Dielectric materials, dielectric constant, electric dipole in an electric field, polarization, polarization types, frequency dependence of polarisibilty. Capacitors, types of capacitors, capacitors with dielectrics, numericals.	16 Hrs
Unit III	
Chapter No. 4 ELECTROMAGNETICS: Analysis Model: Particle in a magnetic field, motion of a charged particle in a uniform magnetic field, applications involving charged particles moving in a magnetic field, magnetic force acting on a current-carrying conductor, torque on a current loop in a uniform magnetic field. Sources of the Magnetic Field: The Biot–Savart's law, magnetic force between two parallel conductors, Ampere's law, Faraday's law: Faraday's law of induction, motional emf, Lenz's law, Numericals.	08 Hrs

Text Books :

1. David. A. Bell, "Electronics Devices and Circuits", 5th Edition, Oxford University Press.

2. Electronic Devices and Circuits, 11th Edition by Boylested, Pearson Publications

3. Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 9th Edition, CENGAGE learning, 2014.

1. eBook: Physics for Scientists and Engineers, A strategic Approach, 3rd edition, by Randal D. Knight.
2. Solid state devices and technology- by V. Suresh Babu, sanguine technical publisher.
3. S. O. Pillai, Solid state physics, 6th Edition, New age International, 2006.
4. A text book of Engineering Physics by M. N. Avadhanulu; P.G. Kshirasagar, S. Chand Co. 2010.

Reference Books:

1. Jacob Millman and Christos Halkias, "Electronic Devices and Circuits" TMH edition, 1995.
2. R. P. Feynman, Robert. B. Leighton, Matthew Sands, The Feynman Lectures on Physics, Vol-II, Norosa Publishing House, 1998.
3. David. J. Griffith, 'Introduction to Electrodynamics' 3rd edition, Pearson prentice Hall, 1999.
4. Ben. G. Streetman, Solid State Electronic Devices, Prentice Hall, 1995.

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Program: Electrical & Electronics Engineering		**Semester: II**
Course Title: Multivariable Calculus		**Course Code: 18EMAB102**
L-T-P: 4-1-0	**Credits: 05**	**Contact Hours: 5 Hrs / Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours : 50 Hrs	**Exam Duration: 3 Hrs.**	

Unit I	
Chapter No. 1 Partial differentiation Function of several variables, Partial derivatives, Level curves, Chain rule, Errors and Approximations. Extreme value problems. Lagrange's multipliers.	12 Hrs
Chapter No. 2 Double integrals Double integrals- Rectangular and polar coordinates, Change the order of integration. Change of variables, Jacobian. Application of double integrals MATLAB: optimization problems, application of double integrals	08 Hrs
Unit II	
Chapter No. 3 Triple integrals Triple integrals, Cartesian, change to Cylindrical and Spherical coordinates Application of Triple integrals	07 Hrs
Chapter No. 4 Calculus of Vector Fields Vector fields, Gradient and directional derivatives. Line and Surface integrals. Independence of path and potential functions. Green's theorem, Divergence of vector field, Divergence theorem, Curl of vector field. Stokes theorem. MATLAB: application of Triple integrals, Vector calculus problems	13 Hrs
Unit III	
Chapter No. 5 Differential equations of higher orders (a) Linear differential equations of second and higher order with constant coefficients The method of Variation of parameters. Initial and boundary value problems. (b) Applications of second order differential equations-Newton's 2nd law, electrical circuits, Simple Harmonic motion. Series solution of differential equations. Validity of Series solution of Differential equations. MATLAB: application of differential equations	(5+5) Hrs
Text Books : **1.** Early Transcendental Calculus- James Stewart, Thomson Books, 7ed 2010	
Reference Books: 1. Calculus Single and Multivariable, Hughues-Hallett Gleason, Wiley India Ed, 4ed, 2009. 2. Thomas Calculus, George B Thomas, Pearson India, 12ed, 2010	

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Program: Electrical & Electronics Engineering		**Semester: II**
Course Title: Basic Electronics		**Course Code: 18EECF101**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50 Hrs	**Examination Duration: 3 Hrs**	

Unit I	
Chapter No. 1: Trends in Electronic Industries: Introduction, Roadmap of electronic sector, scope and opportunities in various segments of electronics (i.e., Consumer, Telecom, IT, Defence, Industrial, Medical and Automobiles), Government and private sectors, Growth profile of Electronic industries, Standards and Policies, Electronic System Components.	03 Hrs
Chapter No. 2: Basic Components, Devices and Applications: Diode: PN junction characteristics; modelling as a circuit element, ideal and practical diode. AC to DC converter: Half wave and full wave rectifier (centre tap and bridge), capacitor filter and its analysis, numerical examples. Zener diode and its applications (Voltage reference and voltage regulator). Realization of simple logic gates like AND and OR gates.	10 Hrs
Chapter No. 3: Transistor: BJT, transistor voltages and currents, Signal amplifier (Fixed bias, Collector base bias, Voltage divider bias, CE configuration). DC load line. Voltage, current and power gains. Transistor as a switch: NOT Gate, Basic (DTL) NAND gate. Transistor as a Small Signal Amplifier (Single Stage and Two Stage RC-coupled Amplifier).	07 Hrs
Unit II	
Chapter No. 4: Digital Logic: Number systems: Decimal, Binary, Octal and Hexadecimal number systems, Conversions, Binary Operations-Addition and subtraction in binary number systems. Logic gates: Realization of simple logic functions using basic gates (AND, OR, NOT), Realization using universal gates (NAND, NOR). Boolean algebra: Theorems and postulates, De-Morgan's Theorems , simplification of logical expressions, Karnaugh Maps, Use of Karnaugh Maps to Minimize Boolean Expressions (2 Variables, 3 Variables and 4 Variables), Design of Half Adder and Full Adder, Parallel Adder using full adders.	14 Hrs
Chapter No. 5: Operational Amplifier: OPAMP characteristics (ideal and practical), Linear and non-linear applications: Inverting amplifier, Non inverting amplifier, Voltage follower, Integration, Differentiation, Adder, Subtractor, ZCD and Comparator.	06 Hrs
Unit III	

Chapter No. 6: Communication Systems: Basic block diagram of communication system, types of modulation. Amplitude modulation: Time-Domain description, Frequency-Domain description. Generation of AM wave: square law modulator. Detection of AM waves: envelope detector. Double side band suppressed carrier modulation (DSBSC), Generation of DSBSC wave : balanced modulator, Super heterodyne principle.	07 Hrs
Chapter No. 7: Linear Power Supply, UPS & CRO: Working principle of linear power supply, UPS and CRO. Measurement of amplitude, frequency and phase of a given signal.	03 Hrs

Text Books:

1. David A Bell, Electronic devices and Circuits, PHI New Delhi, 2004
2. K.A Krishnamurthy and M. R. Raghuveer , Electrical, Electronics and Computer Engineering for Scientists and Engineers, 2, New Age International Publishers, 2001
3. A.P. Malvino, Electronic Principles, Tata McGraw Hill, 1999

Reference Books:

1. George Kennedy, Electronic Communication Systems, Tata McGraw Hill, 2000
2. Morris Mano, Digital logic and Computer design , 21st Indian print Prentice Hall India, 2000
3. Floyd, Digital fundamentals, 3, Prentice Hall India, 2001
4. Boylestead, Nashelsky, Electronic devices & Circuit theory, Prentice Hall India, 2000
5. Ramakant Gaikwad , Operational Amplifiers & Applications, PHI, 2000

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Program: Electrical & Electronics Engineering		Semester: II
Course Title: Applied Physics lab (ES)		Course Code: 21EPHP101
L-T-P: 0-0-1	Credits: 01	Contact Hrs: 2 Hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 20	Examination Duration: 03 Hrs	

LIST OF EXPERIMENTS

1. Experimental data error analysis.
2. Centripetal force.
3. Young's modulus.
4. Coefficient of friction.
5. V-I Characteristics of pn- Junction diode and plotting DC load line.
6. Hysteresis loss.
7. Verification of Kirchoff's KVL and KCL (DC Circuits)
8. Use of measuring instruments (RPS & FG) and calibration of oscilloscope
9. Realization of basic gates (Using IC's)
10. Zener diode characteristics and voltage regulation (line and load regulation).

OPEN ENDED EXPERIMENT

1. Realization of a ±5/12V regulated power supply
2. Stepper motor drive

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Program: Electrical & Electronics Engineering		Semester: II
Course Title: Engineering Exploration		Course Code: 22ECRP101
L-T-P: 0-0-3	Credits: 3	Contact Hrs: 6 Hrs/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs: 72	Examination Duration: 3 Hrs	

Unit I	
Module 1: Introduction to Engineering and Engineering Study Introduction to Engineering and Engineering Study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, Expectation for the 21st-century engineer, and Graduate Attributes.	03 Hrs
Module 2: Engineering Design Engineering Design Process, Problem definition formulation process, Concept generation- Function tree, Functional structure, Morphological chart, and Concept selection- Pugh Chart, Product Architecture. Prototyping and testing.	09 Hrs
Module 3: Mechanisms and Resource Specifications (MRS) Mechanism, types of mechanisms, degree of freedom, linkages, four-bar linkage mechanism, actuators & their types, torque, governing equations, FOS, motor sizing, motor selection, mass acquisition using software, power adapters, types of adapters, power calculations & adapter selection.	09 Hrs
Module 4: Platform-Based development Introduction to various platform-based development (Arduino) programming and its essentials, Introduction to sensors, transducers, and actuators and its interfacing with Arduino.	15 Hrs
Module 5. Project Management Introduction to Project Management, Significance of teamwork, Significance of Agile practices, Significance of documentation.	03 Hrs
Module 6. Engineering Ethics Identifying Engineering as a Profession, Significance of Professional Ethics, Code of Conduct for Engineers, Identifying Ethical Dilemmas in different tasks of engineering, Applying Moral Theories and codes of conduct for resolution of Ethical Dilemmas.	03 Hrs
Module 7. Sustainability in Engineering Introduction to sustainability, Sustainability leadership, Life cycle assessment, carbon foot print.	06 Hrs
Course Project **Reviews**	24 Hrs

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Program: Electrical & Electronics Engineering		**Semester: II**
Course Title: Problem Solving with Data Structures		**Course Code: 18ECSP102**
L-T-P: 0-0-3	**Credits: 3**	**Contact : 6 Hrs/week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching : 78 Hrs	**Exam Duration: 3 Hrs**	

Chapter No. 1 Pointers, Structures and Files Recap of basics: Pointers ,Structures; Self-referential structures, dynamic memory management Files – File manipulation programs	12 Hrs
Chapter No. 2 Stacks and Recursion Stack: Definition, Operations, Stack ADT Implementation of stack operations. Applications of stack. Recursion- Need for Recursion and problems on Recursion.	16 Hrs
Chapter No. 3 Queues Queue: Definitions of Linear, Circular queues, Queue ADT Linear and circular queue operations Definition and working of Priority queue, Double ended queue; Applications of queues.	16 Hrs
Chapter No. 4 Lists Concept of lists and dynamic memory management lists, definitions and representations: singly, doubly, circular lists. Dynamic Implementation of lists and its operations, Applications of linked lists	18 Hrs
Chapter No. 5 Binary trees Binary Tree: Definition, Terminology and representation, Tree Traversals both recursive and iterative. Binary Search Tree and its applications.	16 Hrs

Text Books:

1. Data Structures with C -- Seymour Lipschutz, Schaum's Outline Series
2. Data Structures Using C and C++ -- Langsam and Tanenbaum, PHI Publication
3. Data Structures Through C -- Yashavant P Kanetkar, BPB Publication

Reference Books:

1. Data Structures, Algorithms and Applications In C++ -- Satraj Sahani
2. Data Structures and Algorithms Made Easy – Narshiman Karumunchi, Career Monk

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III Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Semester: III**
Course Title: Integral transforms and Statistics		**Course Code: 15EMAB203**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 4 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3 Hours**	

Unit-I	
Chapter No. 1: Laplace Transforms Definition, transforms of elementary functions- transforms of derivatives and integrals- Properties. Periodic functions, Unit step functions and Unit impulse functions. Inverse Transforms- properties- Convolution Theorem. Initial and Final value theorems, examples; Applications to differential equations, Circuit equations	10 Hrs
Chapter No. 1: Probability Definition of probability, conditional probability, Baye's rule, Chebyshev's inequality, random variables- PDF-CDF- Probability Distributions: Binomial, Poisson, Exponential, Uniform, and Normal	10 Hrs
Unit-II	
Chapter No. 2: Regression Introduction to method of least squares, fitting of curves y = a + bx, y = abx, correlation and regression. Engineering problems	05 Hrs
Chapter No. 3: Fourier Series: Complex Sinusoids, Fourier series representations of four classes of signals, Periodic Signals: Fourier Series representations, Derivation of Complex Co-efficients of Exponential Fourier Series and Examples. Convergence of Fourier Series. Amplitude and phase spectra of a periodic signal. Properties of Fourier Series(with proof): Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties.	08 Hrs
Chapter No. 4: Fourier Transform: Fourier representation of non-periodic signals, Magnitude and phase spectra. Properties of Fourier Transform: Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties.	07 Hrs
Unit-III	
Chapter No. 5: Random Process (a) Introduction to Joint Probability Distributions, marginal distribution, joint pdf and cdf, mean, variance, covariance, correlation. (b) Introduction to Random process, stationary process, mean, correlation and covariance function, autocorrelation function, cross correlation, Power spectral Density: properties of the spectral density; Gaussian Process: Properties of Gaussian process.	10 Hrs
Text Books	

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.
2. Gupta S C and Kapoor V K, Fundamentals of Mathematical Statistics, 9ed, Sultan Chand & Sons, New Delhi, 2002
3. Walpole and Myers, Probability and Statistics for Engineers and Scientists,8ed, Pearson Education – Delhi – 2007

Reference Books:

1. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley, 2002.
2. J. Susan Milton, Jesse C. Arnold, Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th Ed, TATA McGraw-Hill Edition 2007
3. Ian Glover & Peter Grant, Digital Communications, 2nd Ed, Pearson 2012.

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Program: Electrical & Electronics Engineering		**Semester: III**
Course Title: Calculus and Integral Transforms (Lateral Entry Students)		**Course Code: 15EMAB232**
L-T-P : 4-0-0	**Credits: 4**	**Contact Hrs: 4 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 50	**Exam Duration: 3hrs**	

Unit - I	
Chapter No. 1 Differential Calculus: Differentiation of standard functions of first and higher orders, Taylor's and Maclaurin's series expansion of simple functions for single variable.	05 Hrs
Chapter No. 2 Integral Calculus: Evaluation of integrals, properties, Beta and Gamma functions, relation between Beta and Gamma functions simple problems. Approximate Integrations- Trapezoidal rule and Simpson's rule	06 Hrs
Chapter No. 3 Laplace Transforms: Definition, transforms of elementary functions- transforms of derivatives and integrals- Properties. Periodic functions, Unit step functions and Unit impulse functions. Inverse Transforms- properties- Convolution Theorem.	09 Hrs
Unit - II	
Chapter No. 4 Fourier Series: Complex Sinusoids, Fourier series representations of four classes of signals, Periodic Signals: Fourier Series representations, Derivation of Complex Co-efficient of Exponential Fourier Series and Examples. Convergence of Fourier Series. Amplitude and phase spectra of a periodic signal. Properties of Fourier Series(with proof): Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties.	08 Hrs
Chapter No. 5 Fourier Transform: Fourier representation of non-periodic signals, Magnitude and phase spectra. Properties of Fourier Transform: Linearity, Symmetry Properties, Time shift, Frequency Shift, Scaling, Time differential differentiation coefficients, Time domain Convolution, Multiplication Theorem, Parseval's theorem and Examples on these properties	06 Hrs
Chapter No. 6 Ordinary Differential Equations of first order: Introduction, order and degree of equation, Solution of first order first-degree differential equations –variable separable methods, Linear differential equations, Initial value problems, solution of differential equations by Laplace transform method.	06 Hrs
Unit - III	
Chapter No. 7 Numerical solution of Initial value problem: Numerical solution of initial value problems by Euler's Method, Modified Euler's method and Runge Kutta Method	05 Hrs
Chapter No. 8 Differential equations of higher orders: Differential equations of second and higher order with constant coefficients	05 Hrs

Text Books:

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.

2. Bali and Iyengar, A text book of Engineering Mathematics, 6ed, Laxmi Publications(p) Ltd, New Delhi,2003

Reference Books:

1. Early Transcendental Calculus- James Stewart, Thomson Books, 5e 2007
2. Ganesh Rao and and Satish Tunga, Signals and Systems, Sanguine T, 2004.
3. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley, 2002
4. Ian Glover & Peter Grant, Digital Communications, 2nd Ed, Pearson 2012.

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Program: Electrical & Electronics Engineering		Semester: III
Course Title: Corporate Communication		Course Code: 22EHSH201
L-T-P: 0.5-0-0	Credits: 0.5	Contact Hrs: 2Hrs/week
ISA Marks: 100	ESA Marks: 0	Total Marks: 100
Teaching Hrs: 16	Exam Duration: N.A.	

Content	
Chapter No. 1. Communication Skills Tools of Communication, Listening, Body Language, Common Postures and Gestures, Open and Closed Body Language, Body Language to be used in Corporate Scenarios, Voice: Pitch, Pace, and Pause, Verbal Language: Positive & Negative Vocabulary, Corporate Conversations	04 Hrs
Chapter No. 2. Presentation Skills Zero Presentation, Individual Presentations, and feedback, Making Presentations Interactive, Types of Questions, Taking off and Signing off differently, Captivating your Audience, Corporate Presentations	04 Hrs
Chapter No. 3. Spoken English Phonetic and Non-Phonetic Languages, Introduction to IPA, Sounds in English, Syllables, Word Stress, Rhythm, Pausing, and Intonation	04 Hrs
Chapter No. 4. Written English Vocabulary Enhancement Strategies, Root Words in English, Grammar Improvement Techniques, Dictionary Usage, Similar and Contradictory Words	04 Hrs
Reference Books: 1. Diana Booher - Communicate With Confidence, McGraw Hill Publishers 2. Norman Lewis–Word Power Made Easy, Goyal Publishers 3. Cambridge Advanced Learner's Dictionary, Cambridge University Press.	

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Program: Electrical & Electronics Engineering		**Semester: III**
Course Title: Circuit Analysis		**Course Code: 19EEEC201**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/ Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Exam Duration: 3 Hours**	

Unit-I	
Chapter No.1 Network Equations: Source Transformation, Star Delta transformation, Nodal Analysis, Super node, Mesh Analysis, Super mesh, Duality, Network Topology, Tie Set and Cut Set matrix formulation, Dot convention.	10 Hrs
Chapter No.2 Network Theorems: Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Milman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks	10 Hrs
Unit-II	
Chapter No.3 Two Port Networks: Two port variables, Z, Y, H, G, A- Parameter representations, Input and output impedance calculation, Series, Parallel and Cascade network connections, and their (suitable) models.	04 Hrs
Chapter No.4 First order circuits: Order of a system, Concept of Time constant, System Governing equation, System Characteristic equation, Basic RL & RC circuit, Transient response with initial conditions, Frequency response characteristics, R-C , R-L circuits as differentiator and integrator models, time and frequency domain responses R-C , R-L circuits as Low pass and high pass filters	06 Hrs
Chapter No.5 Higher order circuits: Higher order R-C, R-L, and R-L-C networks, time domain and frequency domain representation, Series R-L-C circuit, Transient response, Damping factor, Quality factor, Frequency response curve , Peaking of frequency curve and its relation to damping factor, Resonance Parallel, R-L-C circuit, Tank circuit, Resonance, Quality factor and Bandwidth	10 Hrs
Unit-III	
Chapter No.6 Sinusoidal Steady state analysis: Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasors & Phasor diagrams.	05 Hrs
Chapter No.7 Polyphase Circuits: Polyphase systems, Single Phase three wire system, Three phase Y-Y connection, Delta connection, Analysis of balanced & unbalanced three phase circuits.	05 Hrs

Text Books

1. W H Hayt, J E Kemmerly, S M Durban, Engineering Circuit Analysis, 6th, McGraw Hil, 2006
2. M E. Van Valkenburg, Network Analysis, 3rd, Pearson Ed, 2006

Reference Books:

1. Joseph Edminister, Mahmood Nahavi, Electric Circuits, 3rd, Tata McGra, 1991
2. Bruce Carlson, Circuits, 3rd, Thomson Le, 2002
3. V. K. Aatre, Network Theory and Filter Design, 2nd, Wiley West, 2002
4. Anant Agarwal and Jeffrey H Lang, Foundations of Analog & Digital Electronics Circuits, 3rd, Morgan Kau, 2006
5. Muhammad H . Rashid, Introduction to PSPICE using OrCAD for circuits and Electronics, 3rd, Pearson Ed, 2005

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Program: Electrical & Electronics Engineering		**Semester: III**	
Course Title: Analog Electronics Circuits		**Course Code: 23EEEC201**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 50	**Exam Duration: 3 Hours**		
Unit-I			
Chapter 1:Diode Models and Circuits Diode models: Exponential model, piecewise linear model, constant voltage drop model, ideal diode model, small signal diode model and their circuit representations. Applications of diode: Clipper circuits, clamper circuits for with/without DC voltage biasing conditions and Voltage doubler circuits. Numericals on diode models and applications. (T1: 2.2, 2.3.1 to 2.3.8, 2.6.1to 2.6.3.)			06 Hrs
Chapter 2: Bipolar junction transistors BJT: Transfer characteristics, DC load line and bias point concepts. Biasing of BJT: voltage divider technique. Small signal operation of BJT. BJT as an amplifier: two port H modeling AC analysis of Common Emitter (CE) circuit and derivation of amplifier parameters. Importance of coupling and bypass capacitors in amplifiers. Operation of BJT as a switch. (T1: 3.2.1,3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.3.2, 3.3.4)			05 Hrs
Chapter 3: MOSFETs structure and physical operation: MOSFET Device structure, types of MOSFET's, working principle and operation of NMOS: Depletion type-operation with no gate voltage, positive and negative gate voltage and Enhancement type-operation with no gate voltage, positive and negative gate voltage creating a channel for current flow, applying small V_{DS}, operation as V_{DS} is increased. Derivation of threshold voltage of MOSFET. Operating the MOS transistor in the sub threshold region, pinch off effect, channel length modulation effect. Derivation of the drain current in different regions of operation, I_D-V_{DS} relationship with and without channel length modulation. Finite output resistance (r_{DS} on). PMOS: Drain and Transfer characteristics, circuit symbol, the I_D v/s V_{DS} characteristics, and the role of the substrate-the body effect, temperature effects, breakdown and input protection. DC circuit representations using MOSFET and numericals.			09 Hrs
Unit-II			
Chapter 4: Biasing of MOSFETs MOSFET circuits at DC continued. Biasing MOSFET circuits: By fixing V_{GS}, By fixing V_G, With drain to gate feedback resistor, Constant current source biasing, Application of MOSFET as a switch. Large signal operation, operation as a linear amplifier and numericals. (T1:4.3)			08 Hrs
Chapter 5: MOSFET amplifiers and Introduction to FinFET Technology Small signal operation and its equivalent model of MOSFET. Application of MOS as single stage amplifiers. Derivation of CS, CG and CD amplifiers parameters and its comparison. Implications on gain and Bandwidth. High frequency model of the MOSFET considering the internal capacitance. introduction to Fin Field Effect Transistor , Challenges of MOSFET Scaling at Nanometer Mode, Active Area, Fin width, height and pitch, Threshold Voltage and Gate Work function Requirements, Gate EWF and Gate Induced Drain Leakage, V-I			12 Hrs

Characteristics (T1:4.4,4.5, 4.6.1 to 4.6.7 ; 4.7.1, 4.7.2, 4.7.3, 4.7.5, 4.7.6, 4.7.7;4.8.1,4.8.2,4.8.3,4.8.4, 4.9.1 to 4.9.3) (T4: 1.1, 1.2) (R5: 2.1, 2.3)	
Unit-III	
Chapter 6: Feedback Amplifiers General feedback structure (Block schematic) and types of feedback topologies. Feedback Amplifiers: series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples. Feedback de-sensitivity factor, Nyquist stability Criterion for positive and negative feedback circuits. Oscillators: RC phase shift oscillator, wein bridge Oscillator, merits of negative feedback, feedback topologies. Numericals on feedback topologies and oscillators. (T1:7.1 to 7.6)	05 Hrs
Chapter 7: Large Signal Amplifiers Classification of amplifiers: (A, B, AB and C) transformer less and transformer coupled amplifier. Transistor case and heat sink. Derivation of power efficiency and power dissipation for different types of large signal amplifiers(T1:12.1 to 12.6;12.8.4)	05 Hrs
Text Books: **1.** A.S. Sedra & K.C. Smith, Microelectronic Circuits, 5th Edition, Oxford Univ. Press, 1999 2. Jacob Millman and Christos Halkias, Integrated Electronics, McGraw Hill, 2000 3. Electronic Devices and Circuit Theory, Robert Boylestad Louis Nashelsky, 11th Edition, Pearson, 2015 4. FinFET Devices for VLSI Circuits and Systems	
Reference Books: 1. David A. Bell, Electronic Devices and Circuits, 4th edition, PHI publication, 2007Grey, Hurst, Lewis and Meyer, Analysis and design of analog integrated circuits 4th edition, 2. Thomas L. Floyd, Electronic devices, Pearson Education, 2002 3. Richard R. Spencer & Mohammed S. Ghousi, Introduction to Electronic Circuit Design, Pearson Education, 2003 4. J. Millman & A. Grabel, Microelectronics , 2nd edition, McGraw Hill, 1987 5. FinFETs and Other Multi-Gate Transistors	

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Program: Electrical & Electronics Engineering		Semester: III
Course Title: Electrical Power Generation, Transmission & Distribution		Course Code: 19EEEC202
L-T-P: 3-0-0	Credits: 3	Contact Hours: 3 Hrs /week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 40	Exam Duration: 3 Hrs	

Unit-I	
Chapter No.1 Selection of site, Classification, General arrangement and operation of Hydro electric plant with Components, General arrangement and operation of Thermal power plant with Components, General arrangement and operation of Nuclear power plant with Components, Safety of Nuclear power reactor, Storing and processing spent fuel	05 Hrs
Chapter No.2 Substations: Types, bus-bar arrangement, schemes, location, substation equipments. Economics: Important terms and curves commonly used in system operation, Effect of Voltage and frequency on Loads, Scheduling of Generators, Choice of size and number of generator units, Interconnection of power stations.	05 Hrs
Chapter No.3 Introduction, electrical supply system, comparison of AC & D.C. Systems, Standard Voltages of Transmission & Distribution, Advantages of High Voltage Power Transmission, (effect of increase in voltage on weight of conductor, Line Efficiency & Line Voltage Drop). Feeders, Distributors & Service Mains, Conductors types.	02 Hrs
Chapter No.4 Line supports & placing of the conductors, single phase and three phase systems. Single circuit and double circuit, Spacing of conductors, Length of span & Sag in OH lines. Sag calculation in conductors (a) Suspended on level supports (b) Supports at different levels, Effect of wind and ice. Tension and sag. Corona: Phenomena, expression for disruptive and visual critical voltages and corona power loss.	03 Hrs
Unit-II	
Chapter No.5 Line parameters Introduction to transmission line constants i.e. Resistance, Inductance and capacitance, Inductance of the single phase & three phase lines, Inductance calculation with equilateral and unsymmetrical spacing of the lines, Transposition of line conductors. Capacitance for single phase & three phase lines, Effect of earth on capacitance of the line, Numerical solutions on resistance calculations.	07 Hrs
Chapter No.6 Characteristics & Performance of Power transmission lines: Introduction to Short transmission lines, calculations for short lines, Medium transmission lines, Nominal-T and ∏ representation for transmission lines, Long transmission lines, Long line solutions by Rigorous method, equivalent models, ABCD constants	08 Hrs
Unit-III	
Chapter No.7 Insulators: Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency and methods of increasing string efficiency, testing of insulators.	05 Hrs

Chapter No.8 Underground Cables: Types, material used. Insulation resistance, thermal rating of cables, charging current. Grading of cables, capacitance grading and inter sheath grading, testing of cables.	05 Hrs

Text Books :

1. Power Station Engineering and Economics by Skrotzki and Wavopat, McGraw Hill, 1995

Reference Books:

1. Principles of Power system By: V.K. Mehta & Rohit Metha. S. Chand & Company, LTD. 2014
2. A course in Electrical Power By: Soni, Gupta & Bhatnagar. Dhanpat rai Publications .2014
3. Transmission & Distribution of Electrical Power By J.B.Gupta. SK Kataria, Publication
4. Electric Power Generation Transmission and Distribution by S. M. Singh, by Prentice Hall of India, Regd. Office: d 13/12, Model Town, Delhi

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Program: Electrical & Electronics Engineering		Semester: III
Course Title: Digital Circuits		Course Code: 19EEEC203
L-T-P: 4-0-0	Credits: 4	Contact Hours: 4 Hrs /week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 50	Exam Duration: 3 Hrs	

Unit-I	
Chapter No.1 Logic Families: Logic levels, output switching times, fan-in and fan-out, comparison of logic families	02 Hrs
Chapter No.2 Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4 variables, incompletely specified functions (Don't care terms), Simplifying Maxterm equations, Quine-McCluskey minimization technique- Quine-McCluskey using don't care terms, Decimal method, Reduced Prime Implicant Tables.	09 Hrs
Chapter No.3 Analysis and design of combinational logic: General approach, Decoders-BCD decoders, Encoders, Digital multiplexers- Using multiplexers as Boolean function generators. Adders and subtractors-Cascading full adders, Look ahead carry adders, Binary comparators.	09 Hrs
Unit-II	
Chapter No.4 Introduction to Sequential Circuits : Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, A Switch De bouncer, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop; Characteristic Equations. Chapter No.	10 Hrs
Chapter No.5 Analysis of Sequential Circuits: Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter using clocked D, T or SR Flip-Flops.	10 Hrs
Unit-III	
Chapter No.6 Sequential Circuit Design Introduction to Sequential Circuit Design, Mealy and Moore Models, State Machine notations, Synchronous Sequential Circuit Analysis, Construction of state Diagrams and counter design.	05 Hrs
Chapter No.7 Introduction to Memories: Introduction and role of memory in a computer system, memory types and terminology, Read Only memory, MROM, PROM, EPROM, EEPROM, Random access memory, SRAM, DRAM, NVRAM.	05 Hrs

Text Books:

1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002
2. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001
3. A Anand Kumar , Fundamentals of digital circuits, PHI, 2003

Reference Books:

1. Charles H Roth, Fundamentals of Logic Design, Thomson Learning, 2004
2. Zvi Kohavi, Switching and Finite Automata Theory, 2nd, TMH
3. R.D. Sudhaker Samuel, Logic Design, Sanguine Technical Publishers, 2005
4. R P Jain, Modern Digital Electronics, 2nd, Tata McGraw Hill , 2000

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Program: Electrical & Electronics Engineering		**Semester: III**
Course Title: Microcontroller Architecture & Programming		**Course Code: 23EEEF201**
LTP: 2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 72 Hrs	**Examination Duration: 2 Hrs**	

Unit -I	
Chapter 1: Microprocessors and Microcontroller Introduction, Microprocessors and Microcontrollers, A Microcontroller Survey, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture.	02 Hrs
Chapter 2: The 8051 Architecture 8051 Microcontroller Hardware, Input / Output Pins, Ports and Circuits, semiconductor Memories, Interfacing external RAM & ROM memories.	04 Hrs
Chapter 3: Addressing Modes and Arithmetic Operations Addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, Data exchanges, stack concept and related instructions, example programs. Logical Operations: Introduction, Byte level, logical Operations, Bit level Logical Operations , Rotate and Swap Operations, Example Programs, Arithmetic Operations: Introduction, Flags, Incrementing and Decrementing, Addition, Subtraction Multiplication and Division, Decimal Arithmetic, Example Programs.	04 Hrs
Unit – II	
Chapter 4: Branch operations Jump Operations: Introduction, The JUMP and CALL, Program range, Jump calls and Subroutines , Interrupts and Returns, Example Problems.	03 Hrs
Chapter 5: 8051 Programming in 'C' Data Types and Time delays in 8051C,I/O Programming, Logic operations, Data Conversion programs, Accessing code ROM space,. Data serialization.	04 Hrs
Chapter 6: Counter/Timer Programming in 8051 Programming 8051 Timers, Programming Timer0 and Timer1 in 8051C	03 Hrs
Unit – III	
Chapter 7: Serial Communication Basics of Serial Communication, 8051 connections to RS-232,8051 Serial Communication modes, Programming, Serial port programming in C.	04 Hrs
Chapter 8: 8051 interfacing and applications Interfacing 8051 to LCD, Keyboard, ADC, DAC, Stepper Motor, DC Motor. **Chapter 9: Interrupts** Introduction to interrupts, interrupts vs polling, classification of interrupts, interrupt priority, interrupt vector table, interrupt service routine	04 Hrs 02 Hrs

Text Books: 1. " The 8051 Microcontroller Architecture, Programming & Applications " by ' Kenneth J. Ayala', Penram International, 1996 2. " The 8051 Microcontroller and Embedded systems ", by ' Muhammad Ali Mazidi and Janice Gillispie Mazidi', Pearson Education, 2003
Reference Books: 1. " Programming and Customizing the 8051 Microcontroller ", by 'Predko', TMH.

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Program: Electrical & Electronics Engineering		Semester: III
Laboratory Title: Analog Electronics Lab		Course Code: 23EEEP201
L-T-P: 0-0-1	Credits: 1	Contact Hours: 2 Hrs /week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hours: 24Hrs	Examination Duration: 2 Hrs	

List of Experiments:

1. Study of multi-meters, power supplies, function generators, Oscilloscopes; Identification of various components and devices, e.g. resistors, capacitors, diodes, transistors.
2. Design & analyze Diode Clipping circuits.
3. Design & analyze Positive and Negative Clamping circuits.
4. Study of BJT as a Switch.
5. Study the input and output characteristics of MOSFET.
6. To study the basic current mirror circuit.
7. MOSFET as a source follower (Buffer).
8. Study of transformer-less Class B push pull power amplifier and determination of its conversion efficiency
9. Design an amplifier using BJT and determine its gain, input, output impedance and frequency response of RC Coupled single stage BJT amplifier
10. Design an amplifier using MOSFET and determine its gain, input, output impedance and frequency response of a CS amplifier.
11. Design a regulated power supply for the given specifications

**Note-All above experiments are to be conducted along with simulation.

*Analog Electronic Circuits Lab: Simulation of designed circuits using LTSpice Simulator, before implementing the circuits on breadboard.

Reference Books

1. "Integrated Electronics", by Jacob Millman and Christos Halkias, McGraw Hill,
2. "Microelectronic Circuits", by A.S. Sedra & K.C. Smith, 7th Edition, Oxford Univ. Press, 2017.
3. "Electronic Devices and Circuits" by David A. Bell, 4thedition, PHI publication 2007.
4. "Analysis and design of analog integrated circuits," by Grey, Hurst, Lewis and Meyer, 4th edition.
5. Device data sheets.
6. KLETECH Electronics and Communication Engineering Department 2023-24 Analog Electronics Lab manual.

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Program: Electrical & Electronics Engineering		Semester: III
Course Title: Digital Circuits lab		Course Code: 15EEEP203
L-T-P: 0-0-1	Credits: 1	Contact Hours: 2 Hrs /week
ISA Marks: 80	ESA Marks:20	Total Marks: 100
Laboratory Hours: 28	Examination Duration: 2 Hrs	
List of Experiments:		
Demonstration		
Expt. No.1 Verify the truth tables of AND, NOT, OR, XOR, XNOR, NAND & NOR gates using IC's		
Expt. No.2 Characterization of TTL Gates– Propagation delay, Fan-in, Fan-out and Noise Margin.		
Expt. No.3 To verify of Flip-flops (a) JK Master Slave (b) T-type and (c) D-Type		
Exercise		
Expt. No.4 Design and implement binary to gray, gray to binary, BCD to Ex-3 and Ex-3 to BCD code converters.		
Expt. No.5 Design and implement BCD adder and Subtractor using 4 bit parallel adder.		
Expt. No.6 Design and implement n bit magnitude comparator using 4- bit comparators.		
Expt. No.7 Design and implement Ring and Johnson counter using shift register.		
Expt. No.8 Design and implement mod-6 synchronous and asynchronous counters using flip flops.		
Structured Enquiry		
Expt. No.9 Design and implement given functionality using decoders and multiplexers		
Expt. No.10 Design and implement a digital system to display a 3 bit counter on a 7 segment display. Demonstrate the results on a general purpose PCB.		
Reference Books:		
1. Donald D Givone, Digital Principles and Design, Tata McGraw Hill Edition, 2002		

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Program: Electrical & Electronics Engineering		Semester : III
Course Title: C Programming		Course Code: 18EEEF201
L-T-P : 0-0-2	Credits : 2	Contact Hrs : 04 Hrs/week
ISA Marks : 80	ESA Marks : 20	Total Marks : 100
Teaching Hrs: 48	Exam Duration:2 Hrs	

Expt. 1 Introduction to C Programming Introduction to algorithms / flowcharts and its notations.	02 Hrs
Expt. 2 Basics of C programming language Characteristics and uses of C, Structure of C program, C Tokens: Keywords, Identifiers, Variables, Constants, Operators, Data-types, Input and Output statements.	07 Hrs
Expt. 3 Decision control statements Conditional branching statements: if statement, if else statement, else if ladder, switch statement, unconditional branching statements: break, continue.	06 Hrs
Expt. 4 Iterative statements while, do while, for, nested statements	03 Hrs
Expt. 5 Functions Introduction, Function declaration, definition, call, returns statement, passing parameters to functions, introduction to macros.	10 Hrs
Expt. 6 Arrays and Strings Introduction, Declaration, Accessing elements, Storing values in arrays, Operations on one dimensional array, Operations on two dimensional arrays	10 Hrs
Expt. 7 Pointers Introduction, declaring pointer, pointer variables, pointer expression and arithmetic, passing arguments to functions using pointers, pointers and arrays, passing an array to a function.	05 Hrs
Expt. 8 Structures and Unions Introduction, passing structures to functions, Array of structures, Unions	05 Hrs

Text Books

1. Yashvant Kanetkar, Let us C, 15th ed, BPS Publication, 2016.

Reference Books:

1. B W Kernighan, D M Ritchie, The Programming language C, 2ed, PHI, 2004.
2. B S Gottfried, Programming with C, 2ed, TMH, 2006.
3. B.A. Forouzan, R.F. Gilberg, A Structured Program Approach Using C, 3ed, CENGAGE Learning, 2008.

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IV Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Semester: IV**
Course Title: Linear Algebra and Partial differential equations		**Course Code: 15EMAB208**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 04 Hours/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3 Hours**	

Unit-I	
Chapter No. 1 Matrices and Linear Equations: Introduction, Geometry of Linear equations, Elementary operations, Systems in Echelon form, pivot and free variables, Gaussian elimination , Application to electrical circuits	06 Hrs
Chapter No.2 Vector spaces: Vector Spaces and Subspaces, Solving AX=0 and AX=B, Linear combination of vectors, spanning set, Linear independence, Basis and Dimensions, Column space, Row space and Null space	08 Hrs
Chapter No. 3 Orthogonalality: Inner product spaces, Orthogonal and Orthonormal vectors, Gram-Schmidt process, QR-factorization; Eigenvalues and Eigenvectors, Diagonalizating matrices	06 Hrs
Unit-II	
Chapter No.4 Partial differential equations: Introduction, classification of PDE, Formation of PDE, Solution of equation of the type Pp + Qq = R, Solution of partial differential equation by direct integration methods, method of separation of variables. Modeling: Vibration of string-wave equation, heat equation. Laplace equation. Solution by method of separation of variables	10 Hrs
Chapter No.5 Finite difference method Finite difference approximations to derivatives, finite difference solution of parabolic PDE, explicit and implicit methods; Hyperbolic PDE-explicit method, Elliptic PDE-initial-boundary Value problems.	10 Hrs
Unit-III	
Chapter No.6 Complex analysis: Function of complex variables. Limits, continuity and differentiability. Analytic functions, C-R equations in Cartesian and polar forms, construction of Analytic functions (Cartesian and polar forms).	05 Hrs
Chapter No.7 Complex Integration Line integral, Cauchy's theorem- corollaries, Cauchy's integral formula. Taylor's and Laurent Series, Singularities, Poles, Residue theorem – problems.	05 Hrs

Text Books

1. Gilbert Strang, Linear Algebra and its Applications, 4ed, Thomson India Edition, 2007.
2. David C Lay, Linear Algebra and its Applications, 3ed, Pearson India, 2009
3. Peter V. O'neil, Advanced Engineering Mathematics, Thmoson – Books/Cole, Singapore

4. Advanced Engineering Mathematics, 3ed, Dennis G Zill and Michael R Cullin, Narosa Publishing House, New Delhi, 2009

Reference Books:

1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003.
2. Schaum's Outline of Linear Algebra Seymour Lipschutz, Marc Lipson 4ed, McGraw Hill India 2009
3. Stanley J Farlow, Partial differential equations for Scientists and Engineers, Dover publications, INC, New York, 1993

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Program: Electrical & Electronics Engineering		**Semester: IV**	
Course Title: Vector Calculus and Differential equations		**Course Code: 15EMAB242**	
L-T-P: 4-0-0	**Credits: 4**	**Contact Hrs: 4Hrs**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hrs: 50	**Exam Duration: 3 hrs**		
Unit – I			
Chapter No. 1 Partial differentiation Function of several variables, Partial derivatives, Chain rule, Errors and approximations			07 Hrs
Chapter No. 2 Multiple integrals Double integral, Evaluation by change of order, change of variables, simple problems, Triple integrals simple problems			07 Hrs
Chapter No. 3 Vector Algebra Vector addition, multiplication (Dot and Cross products), Triple products			06 Hrs
Unit – II			
Chapter No. 4 Vector Calculus Vector functions, Vector differentiation, Velocity and Acceleration of a vector point function, Vector fields, Gradient and directional derivatives. Line and Surface integrals. Independence of path and potential functions. Green's theorem, Divergence of vector field, Divergence theorem, Curl of vector field. Stokes theorem.			20 Hrs
Unit – III			
Chapter No. 5 Partial differential equations (a) Introduction, classification of PDE, Formation of PDE, Solution of equation of the type Pp + Qq = R, Solution of partial differential equation by direct integration methods, method of separation of variables. (b) Modeling: Vibration of one-dimensional string-wave equation and heat equation. Laplace equation. solution by method of separation of variables			10 Hrs
Text Books: 1. Kreyszig E., Advanced Engineering Mathematics, 8ed, John Wiley & sons, 2003. 2. Bali and Iyengar, A text book of Engineering Mathematics, 6ed, Laxmi Publications(p) Ltd, New Delhi,2003Early Transcendental Calculus James Stewart, Thomson Book's 5e 2007			
Reference Books: 1. Early Transcendentals Calculus- James Stewart, Thomson Books, 5e 2007 2. Grewal B S, Higher Engineering Mathematics, 38ed, Khanna Publication, New Delhi, 2001			

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Program: Electrical & Electronics Engineering		Semester: IV
Course Title: Problem Solving & Analysis		Course Code: 22EHSH202
L-T-P: 0.5-0-0	Credits: 0.5	Contact Hrs: 1Hr/week
ISA Marks: 100	ESA Marks: 0	Total Marks: 100
Teaching Hrs: 16	Exam Duration: N.A.	

Content	
Chapter No. 1. Analytical Thinking Analysis of Problems, Puzzles for practice, Human Relations, Direction Tests; Looking for Patterns: Number and Alphabet Series, Coding Decoding; Diagrammatic Solving: Sets and Venn diagram-based puzzles; Visual Reasoning, Clocks and Calendars	04 Hrs
Chapter No. 2. Mathematical Thinking Number System, Factors and Multiples, Using Simple Equations for Problem Solving, Ratio, Proportion, and Variation	04 Hrs
Chapter No. 3. Verbal Ability Problem Solving using Analogies, Sentence Completion	04 Hrs
Chapter No. 4. Discussions & Debates Team efforts in Problem Solving; A Zero Group Discussion, Mock Group Discussions, and Feedback; Discussion v/s Debate; Starting a Group Discussion: Recruitment and other Corporate Scenarios; Evaluation Parameters in a Recruitment Group Discussion, Types of Initiators: Verbal and Thought, Conclusion of a Discussion	04 Hrs
Reference Books: 1. R. S. Aggarwal, "A Modern Approach to Verbal and Non – Verbal Reasoning", Sultan Chand and Sons, New Delhi, 2018 2. R. S. Aggarwal, "Quantitative Aptitude", Sultan Chand and Sons, New Delhi, 2018 3. Chopra, "Verbal and Non – Verbal Reasoning", MacMillan India 4. M. Tyra, "Magical Book on Quicker Maths", BSC Publications, 2018 5. Diana Booher - Communicate With Confidence, McGraw Hill Publishers 6. Norman Lewis–Word Power Made Easy, Goyal Publishers 7. Cambridge Advanced Learner's Dictionary, Cambridge University Press. 8. Kaplan's GRE guide	

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Program: Electrical & Electronics Engineering		Semester: IV
Course Title: Electrical Machines		Course Code: 19EEEC204
L-T-P : 4-0-0	Credits: 4	Contact Hours: 04 Hrs /week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 50	Exam Duration: 3 Hrs	

Unit – I	
Chapter 1: Transformers: Single phase transformer- Principle of operation and construction, Ideal transformer, Real transformer, Phasor diagrams, Equivalent circuit, Open-circuit test, Short-circuit test, Voltage regulation, Efficiency, Three phase transformers.	07 Hrs
Chapter 2: Induction Machines: Construction, Fundamental relationships- Slip, Rotor speed, Input power, Electromagnetic power, Electromagnetic (developed) torque, Mechanical power, Efficiency, Shaft torque. , Equivalent circuit, No-load and locked-rotor tests, Torque-speed characteristics, Starting, Speed control.	08 Hrs
Unit – II	
Chapter 3: DC Machines: Principle of operation, Construction of DC machine, Fundamental equations, Armature reaction, Classification of DC machines, DC generators, DC motors, Starting, Speed control of DC motors ,Braking, Switched Reluctance Machines- Construction, Aligned and unaligned positions, Electromagnetic torque, Advantages, disadvantages and Applications of SRMs. Permanent magnet DC brushless motors.	08 Hrs
Chapter 4: Synchronous Machines: Construction, Classification of synchronous machines, Electromotive force induced in armature winding, Generator and motor operation, Phasor diagrams of synchronous machine with Non-salient pole rotor and salient pole rotor, Operation of synchronous generators, Synchronous motor.	07 Hrs
Unit – III	
Chapter 5: Synchronous Machines: Permanent magnet synchronous motors, Air gap magnetic flux density, Equivalent circuit of PM synchronous machine, Phasor diagram, Performance Characteristics of PM synchronous machine, Starting.	05 Hrs
Chapter 6: Single phase induction motors: Double revolving field theory, Equivalent circuit, Split-phase induction motor, Capacitor-start induction motor, Permanent split capacitor induction motor, Capacitor start capacitor-run induction motor, and Shaded pole induction motor.	05 Hrs
Text Books: Jacek F. Gieras, "Electrical Machines: Fundamentals of Electromechanical Energy Conversion", CRC Press, Taylor & Francis Group, 2017.	
Reference Books: 1. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons Publications, Canada, 2nd Edition, 2001. 2. Bhimbra, "Principles of Electrical machinery", Khanna Publishers.2006. 3. MehrdadEhsani…[et al.],"Modern electric, Hybrid electric, and Fuel Cell Vehicles:	

fundamentals, theory, and design.", CRC Press, 2005.
4. T. J. E.Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives", Oxford Science Publications, 1989.

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Program: Electrical & Electronics Engineering		**Semester: IV**
Course Title: Linear Control Systems		**Course Code: 17EEEC204**
L-T-P : 3-0-0	**Credits: 3**	**Contact Hours: 03 Hrs /week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Exam Duration: 3 Hrs**	

Unit-I	
Chapter No.1 Introduction to control systems: Open loop and closed loop control systems-definitions, salient features and simple examples	02 Hrs
Chapter No.2 Transfer function Models and block diagram representation: Definition of transfer function, assumptions and properties, Block diagram and signal flow graph representation, symbols used. Block-diagram of negative and positive feedback systems. Electrical systems: Derivation of transfer functions for electrical circuits, Models of dc servomotors-armature and field control, block-diagram representation. Block diagram reduction rules, Examples.	06 Hrs
Chapter No.3 Time Response Analysis Poles and Zeros, Type and order, Standard test signals. First order system: unit step response, importance of time constant, Second order system: Standard T.F of second order system. Unit step response of 2^{nd} order system Time response specifications-definition. Expressions for rise time, peak time, peak overshot and settling time, Static error constants and steady-state errors.	07 Hrs
Unit-II	
Chapter No.4 Stability Analysis of control systems: Explanation of Routh-Hurwitz criterion-necessary and sufficient condition for stability, special cases, Absolute and Relative stability, relative stability analysis.	05 Hrs
Chapter No.5 Controller design approaches: Basic modes of controls and their features: On-Off, proportional, integral, PI, PD and PID, Controller design approaches- Zeigler Nichol's tuning method and Pole placement design method, design examples	05 Hrs
Chapter No.6 Frequency response analysis: Sinusoidal response: system response for sinusoidal inputs, sinusoidal transfer functions. Frequency response of a second order system, definitions and expressions of Frequency response specifications. Polar plot: method to draw approximate polar plot, definition of phase and gain margin.	05 Hrs
Unit-III	
Chapter No.7 Bode plot analysis of control systems: Bode plots: asymptotic plots for basic factors, method to draw Bode asymptotic plot and phase plot, determination of gain and phase margins from Bode plot.	05 Hrs
Chapter No.8 Root locus diagrams: Basic principle – magnitude and angle criterion, Rules to construct root locus diagram (proof not required), method to construct root locus diagram.	05 Hrs

Text Books 1. Nagarath and Gopal, *Control system Engineering,* Wiley Eastern Ltd., 1995, 2nd edition. 2. Katsuhiko Ogata, *Modern Control Engineering,* PHI, 2002, 4th edition
Reference Books: 1. M.Gopal, Control Systems-Principles and Design, 2, TMH, 2002.

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Program: Electrical & Electronics Engineering		Semester: IV	
Course Title: ARM Processor & Applications		Course Code: 23EEEC202	
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 40	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hrs: 40	Exam Duration: 3 Hrs		
Unit - I			
Chapter No. 1 ARM Architecture The Acorn RISC machine, Architectural inheritance, Architecture of ARM7TDMI, ARM programmers model, ARM development tools, 3 stage pipeline ARM organization, ARM instruction execution.			05 Hrs
Chapter No. 2 Introduction to ARM instruction set Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs, Introduction to Thumb instructions and implementation			08 Hrs
Chapter No. 3 Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features, Optimization techniques and examples.			02 Hrs
Unit - II			
Chapter No. 4 Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.			04 Hrs
Chapter No. 5 Introduction to Bus protocols: I2C, SPI, AMBA (Advanced Memory Bus Architecture): AHB, APB			04 Hrs
Chapter No. 6 LPC 2148 Controller Architectural overview and GPIO programming LPC2148 architectural overview, Registers, GPIO Programming: LED,LCD, Seven segment, Stepper Motor, DC Motor, Buzzer, Switch, Keypad.			07 Hrs
Unit - III			
Chapter No. 7 On-chip programming techniques using LPC 2148 Controller ARM interfacing techniques and programming: Timers, RTC, UART, ADC, DAC, I2C and External Interrupt.			05 Hrs
Chapter No. 8 Architectural support for high level languages Abstraction in software design, data types, floating point data types, The ARM floating point architecture, use of memory, run time environment.			05 Hrs
Text Books: **1.** Steve Furber, ARM System- on-Chip Architecture, 2nd, LPE, 2002 2. William Hohl, ARM Assembly Language fundamentals and Techniques, 1st, CRC press, 2009			
Reference Books: **1.** "ARM system Developer's Guide"- Hardbound, Publication date: 2004 Imprint: MORGAN KAUFFMAN 2. User manual on LPC21XX.			

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Program: Electrical & Electronics Engineering		**Semester: IV**
Course Title: Signals and Systems		**Course Code:19EEEC205**
L-T-P: 3-0-0	**Credits:3**	**Contact Hours: 3 Hrs/week**
ISA Marks: 50	**SEA Marks:50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit-I	
Chapter No. 1. Introduction and Classification of signals: Definition of signal and systems. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and time folding. Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.	08 Hrs
Chapter No. 2. Time domain representation of LTI System: Definition of impulse response, convolution sum, convolution integral ,computation of convolution sum using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution.	07 Hrs
Unit-II	
Chapter No. 3. Fourier Representation of Periodic Signals: Fourier Representation of Periodic Signals: Introduction to CTFS and DTFS, definition, properties and basic problems.	05 Hrs
Chapter No. 4. Fourier Representation of aperiodic Signals: FT representation of aperiodic CT signals, definition, FT of standard CT signals, Properties and their significance. FT representation of aperiodic discrete signals DTFT, definition, DTFT of standard discrete signals, Properties and their significance, Impulse sampling and reconstruction: Sampling theorem and reconstruction of signals.	10 Hrs
Unit-III	
Chapter No. 5: Z-Transforms: Introduction, the Z-transform, properties of the Region of convergence, Properties of the Z-Transform, Inversion of the Z-Transform, Implementation of discrete time of LTI systems.	10 Hrs
Text Books: 1. Simon Haykin and Barry Van Veen, Signals and Systems –2nd Edition, John Wiley, 2004	

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Program: Electrical & Electronics Engineering		Semester: IV
Course Title: Power Electronics		Course Code: 20EEEC201
L-T-P: 3-0-0	Credits: 3	Contact Hours: 40
CIE Marks: 50	SEE Marks: 50	Total Marks: 100
Teaching Hours: 40	Exam Duration: 3 Hrs	

Unit-I	
Chapter No. 1. Introduction Power Electronics, Converter Classification, Electronic Switches: The Diode, Thyristor, Transistors.	02 Hrs
Chapter No. 2. Power Computations Introduction, Power and Energy, Instantaneous Power, Energy, Average Power, Inductors and Capacitors, Effective Values: RMS, Apparent Power and real Power, Power Factor, Power Computations for Sinusoidal AC Circuits, Power Computations for non-sinusoidal periodic waveforms.	04 Hrs
Chapter No. 3. DC-DC Converters Linear voltage regulators, Properties and assumptions, the buck converter, Voltage and Current Relationships, output voltage ripple, design considerations, the boost converter, Voltage and Current Relationships, Output Voltage Ripple, the Buck-Boost Converter, Voltage and Current Relationships, Output Voltage Ripple, Cuk converter.	09 Hrs
Unit-II	
Chapter No. 4. Inverters Introduction, the full-bridge converter, the square-wave inverter, Fourier series analysis, total harmonic distortion, pulse-width-modulated output: bipolar switching, unipolar switching, three-phase inverters	07 Hrs
Chapter No. 5. Controlled Rectifiers The controlled half-wave rectifier, resistive load, RL load, RL-source load, controlled full-wave rectifiers, resistive load, RL load, discontinuous current, RL load, continuous current, controlled rectifier with RL-Source Load, controlled single-phase converter operating as an inverter.	08 Hrs
Unit-III	
Chapter No. 6. AC Voltage Controllers Introduction, The Single-Phase AC Voltage, Controller, Basic Operation, Single-Phase Controller with a Resistive Load, Single-Phase Controller with an RL Load, Static VAR Control.	05 Hrs
Chapter No.7. Drive Circuits, Snubber Circuits and Heat Sinks Introduction, MOSFET gate drive using buffers, MOSFET gate drive using BJT, MOSFET gate drive with isolation, Over-current protection.	05 Hrs
Text Books: 1. Daniel W Hart, Power Electronics, Tata McGraw-Hill Edition, New-Delhi, 2011.	
Reference Books: 1. Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3rd edition, PHI, New Delhi, 2000. 2. P. S. Bhimbra, Power Electronics, Khanna Publishers, 2007. 3. Umanand, Power Electronics, 2nd edition, Wiley-India Publications, New –Delhi, 2009.	

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Program: Electrical & Electronics Engineering		Semester : IV
Course Title: Digital System Design using Verilog		Course Code: 18EEEP203
L-T-P: 0-0-2	Credits: 2	Contact Hours: 4Hrs/week
ISA Marks: 80	SEA Marks:20	Total Marks: 100
Teaching + Lab. Hours: 48 Hrs	Examination Duration: 2 Hrs	

List of Experiments	
Expt. No. 1. Architecture of FPGA Architecture of FPGS: Spartan 3, What Is HDL, Verilog HDL Data Types and Operators.	04 Hrs
Expt. No. 2. Data Flow Descriptions Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors, Testbench.	06 Hrs
Expt. No. 3. Behavioral Descriptions Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements, Tasks and Functions	10 Hrs
Expt. No. 4. Structural Descriptions Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements	10 Hrs
Expt. No. 5 Finite State Machine: Moore Machines, Mealy Machines	04 Hrs
Expt. No. 6 Timing Issues in Digital Circuits: Setup Time Constraints, Hold Time Constraints, Static Time analysis, Critical Path, Clock Skew.	06 Hrs
Expt. No. 7. Advanced HDL Descriptions File operations in Verilog, Memories: RAM, ROM, Block Memories(Xilinx IP)	08 Hrs

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Program: Electrical & Electronics Engineering		Semester: IV
Course Title: ARM Microcontroller Lab		Course Code: 23EEEP202
L-T-P: 0-0-1	Credits: 1	Contact Hours: 2Hrs/week
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Teaching Hours: 25Hrs	Examination Duration: 2 Hrs	
Exercise Experiments		
Expt No.1 Write an ALP to achieve the following arithmetic operations: i. 32 bit addition ii. 64 bit addition iii. Subtraction iv. Multiplication v. 32 bit binary divide Apply suitable machine dependent optimization technique and analyze for memory and time consumed.		
Expt No.2 Write an ALP for the following using loops: i. Find the sum of 'N' 16 bit numbers ii. Find the maximum/minimum of N numbers iii. Find the factorial of a given number with and without a look up table. Apply suitable machine dependent optimization technique and analyze for memory and time consumed.		
Expt No.3 Write an ALP to i. Find the length of the carriage return terminated string. ii. Compare two strings for equality. Apply suitable machine dependent optimization technique and analyze for memory and time consumed		
Expt No.4 Write an ALP to pass parameters to a subroutine to find the factorial of a number or prime number generation. Apply suitable machine dependent optimization technique and analyze for memory and time consumed		
Expt No.5 Write a C program to test working of LEDs and seven-segment and Buzzer using LPC2148.		
Expt No.6 Write a C program to test working of 4X4 keypad, Stepper Motor and DC Motor to LPC2148		
Expt No.7 Develop a C program to demonstrate the concept of serial communication with an example.		
Expt No.8 Write a C program to sample analog data at a specified interval defined using the RTC.		
Expt No.9 Write a C program & demonstrate an interfacing of Alphanumeric I2C based 16x2 LCD panel.		
Expt No.10 Develop an application code to automate the entry of people in the conference hall where the door is opened every 1 sec to allow the entry of people.		
Structured Enquiry		

Expt No.1 Develop an application code using embedded C to accept asynchronous inputs and control the connected device
Expt No.2 Develop an application code using synchronous communication protocol to display the RTC value on a display device.
Open Ended
Expt No.1 Develop an efficient ARM assembly language program that performs matrix multiplication of two square matrices (Matrix A and Matrix B, both of size N x N) with minimum number of cycle count The solution should include one on-chip peripheral and one off-chip peripheral
Expt No.2 Develop an efficient firmware using ARM to demonstrate concept of a calculator with 4X4 keypad, comment on the performance in terms of time, memory and power utilization

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Program: Electrical & Electronics Engineering		**Semester: IV**	
Course Title: Data Structures Applications Lab		**Course Code: 23EEEF202**	
L-T-P: 0-0-2	**Credits: 2**	**Contact Hrs: 4Hrs/Week**	
ISA marks: 80	**ESA marks: 20**	**Total Marks: 100**	
Teaching + Lab Hrs.: 48	**Duration of ESA: 2 Hrs**		
Unit - I			
Chapter No 1. Analysis of algorithms: Introduction, Asymptotic notations and analysis, Analysis of recursive and non-recursive algorithms, master's theorem, complexity analysis of algorithms.			10 Hrs
Chapter No 2. Analysis of linear data-structures and its applications: Complexity analysis of basic data structures (Stacks, Queues, Linked lists)			10 Hrs
Unit - II			
Chapter No 3. Analysis of non-linear data-structures and its applications Trees and applications: Computer representation, Tree properties, Binary Tree properties, Binary search trees properties and implementation, Tree traversals, AVL tree. **Graphs and applications: Computer representation, Adjacency List, Adjacency Matrix,** Graph properties, Graph traversals. Hashing and applications: Hashing, Hash function, Hash Table, Collision resolution techniques, Hashing Applications			28 Hrs
Text Books: 1. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures A Pseudocode Approach with C, Second Edition. 2. Aaron M. Tenenbaum, Data Structures Using C.			

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Program: Electrical & Electronics Engineering		Semester: IV
Course Title: Data Structures using C		Course Code: 23EEEF203
L-T-P: 0-0-3	Credits: 3	Contact Hours: 6 Hrs/week
ISA: 80	ESA: 20	Total Marks :100
Teaching + Lab. Hours: 72 Hrs	Exam Duration: 2 Hrs	
Experiment List		
Expt. No. 1 Programs on pointer concepts		
Expt. No. 2 Programs on string handling functions, structure union and bit files		
Expt. No. 3 Programming on files.		
Expt. No. 4 Programs on implementation of stacks and its applications.		
Expt. No. 5 Programs on implementation of different queue data structures.		
Expt. No. 6 Programs on implementation of different types of Linked lists		
Expt. No. 7 Programs on Implementation of trees.		
Expt. No. 8 Programs to implement different sorting techniques.		
Expt. No. 9 Programming on hash tables		

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V Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Semester: V**	
Course Title: Electric Drives & Control		**Course Code: 24EEEC301**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hrs: 4 Hrs/Week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hrs: 30	**Lab Hrs: 24**	**Exam Duration: 2 Hrs**	
Unit-I			
Chapter No 1. Introduction to electric drives: Fundamental torque equation, speed toque conventions and multi-quadrant operation, components of load torque, nature and classification of load torques Control of electric drives: Closed loop control of drives: current limit control, closed loop torque control, closed loop speed control.			04Hrs
Chapter No 2. DC motor drives: DC motor and their performance: shunt and separately excited motors, series motors, permanent magnet motors. Braking: regenerative braking, dynamic braking, plugging. Speed control, methods of armature control, chopper controlled dc drives, chopper control of separately excited dc motors, chopper control of series motor.			06 Hrs
Chapter 3: Switched Reluctance Motor drives: What is a switched reluctance machine, Aligned and unaligned positions, Electromagnetic torque, Power electronics converters for SRMs: Current hysteresis control, Voltage PWM control.			05 Hrs
Unit II			
Chapter No 4. Induction motor drives: Three phase induction motor: analysis and performance, Braking: regenerative braking, Plugging or reverse voltage braking, speed control, variable frequency control from voltage sources, Voltage Source Inverter (VSI) Control: VSI induction motor drives, braking and multi-quadrant operation of VSI induction motor drives. Closed loop speed control and converter rating of VSI induction motor drives.			10 Hrs
Chapter 5: Permanent magnet synchronous machines and BLDC drives: Permanent magnet synchronous motors, Electromotive force EMF (voltage induced), Electromagnetic (developed) torque, drive system schematics, control strategies, Permanent magnet DC brushless motors and its working principle.			05 Hrs
Lab Experiments to be conducted			
Introduction to Sciamble Workbench Software			
Characterization of a DC motor using Sciamble Kit			
DC Motor speed control using Sciamble Kit			
Four Quadrant Operation of DC Motor using Sciamble Kit			
Step-Down Chopper fed DC Motor Drive using PLECS			
Step-up Chopper fed DC Motor Drive using PLECS			
Closed loop control of chopper fed DC motor drive using PLECS			
Characterization of Squirrel cage IM using Sciamble Kit			

On-line starting of Squirrel cage IM using PLECS
Scalar control of Squirrel cage Induction motor fed by three phase VSI with a given 'V/f'ratio using PLECS
On line starting of Synchronous motor drive using PLECS
Scalar control of Synchronous motor drive fed by three phase VSI with a given 'V/f' ratio using PLECS
Develop and analyze the given control strategy for an DC/AC Motor drive and interpret the results of the simulation, draw practical conclusions from them and prepare a technical report.
Text Books: 1. G. K Dubey, "Fundamentals of Electrical Drives", 2, Narosa Publishing House, Chennai, 2002 2. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, Taylor & Francis Group, 2010.
References: 1. T. J. E.Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives", Oxford Science Publications, 1989. 2. Jacek F. Gieras, "Electrical Machines: Fundamentals of Electromechanical Energy Conversion", CRC Press, Taylor & Francis Group, 2017.

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Program: Electrical & Electronics Engineering		**Semester: V**
Course Title: Power System Analysis and Stability		**Course Code: 17EEEC302**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Exam Duration: 3 Hrs**	

Unit-I	
Chapter No. 1: Power system representation Standard symbols of power system components, one-line diagram, impedance and reactance diagrams, per-unit quantity-definition, per-unit impedance of 3-phase component, change of base, equivalent load impedance, p.u impedance of two-winding transformer referred to primary and secondary, method to draw p.u impedance diagram, advantages of p.u system calculations, examples on obtaining per-unit reactance diagram and per-unit calculations	06 Hrs
Chapter No. 2: Symmetrical fault analysis **3-Phase short circuit at the terminals of unloaded generator, definitions of sub-**transient, transient and steady-state reactance, internal emf's of loaded machines, examples on short circuit calculations, selection of circuit breaker ratings-momentary current and interrupting capacity, examples on symmetrical fault calculations.	05 Hrs
Chapter No. 3: Introduction to Symmetrical components and sequence networks Definition of sequence components as applied to 3-phase unbalanced systems, expressions for sequence components, examples on computations of sequence components.	04 Hrs
Unit-II	
Chapter No. 4: Sequence Networks Sequence impedance and sequence network, sequence networks of 3-phase generator, zero-sequence networks of 3-phase loads and transformers, Sequence network of power systems	04 Hrs
Chapter No. 5: Unsymmetrical Fault Analysis Single line to ground, line to line and double line to ground fault with fault impedance at the terminals of unloaded generator- derivation of connection of sequence networks, Unsymmetrical faults on unloaded power systems, examples on unsymmetrical fault calculation for unloaded power systems.	07 Hrs
Chapter No. 6: Introduction to power system Stability Power angle equation of SMIB system, steady-state analysis, M&H constants-definitions and relation, swing equation, equal area criterion (EAC)	04 Hrs
Unit-III	
Chapter No. 7: Stability analysis by EAC: EAC applications to to-sudden change in mechanical power input, 3-phase fault on transmission line, expression for critical clearing angle, examples on EAC applications	05 Hrs
Chapter No.8: Numerical solution of swing equation for stability analysis	05 Hrs

Point by point method of solving swing equation, applications of Euler, modified Euler and R-K numerical techniques for stability analysis, methods to improve transient stability, examples on stability analysis.	

Text Books:

1. W.D. Stevenson, Elements of Power System Analysis, 4th Edition, McGraw Hill, 1982

2. I.J. Nagarath and D.P. Kothari, Power System Engineering, 2nd Edition, Tata McGraw Hill, 2010

Reference Books:

1. Hadi Sadat, Power System Analysis, First Edition, Tata McGraw Hill, 2002

2. Nagarath and Kothari, Modern Power System Analysis, 2nd Edition, Tata McGraw Hill, 1993

3. J.J. Grainger and W.D. Stevenson, Power System Analysis, McGraw Hill (New York), 1994

Back

Program: Electrical & Electronics Engineering		**Semester: V**
Course Title: OS and Embedded System Design		**Course Code: 24EEEC303**
L-T-P: 3-0-1	**Credits: 4**	**Contact Hours: 5 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Lab Hours: 24**	**Exam Duration: 2 Hrs**

Unit-I	
Chapter No. 1: Introduction to Operating System What is an operating system? Goals of an operating system. Operation of an OS. Operating System Services. System Calls and Types. Operating system Structure – Simple, Layered, Microkernels, Modules and Hybrid Systems. System Boot	03 Hrs
Chapter No. 2: Process Management Process concept- operating on the process, inter-process communication, process scheduling- CPU scheduler-preemptive scheduling, scheduling criteria, scheduling algorithms- first come, first served scheduling, shortest Job first scheduling, priority scheduling, round robin scheduling	05 Hrs
Chapter No. 3: Memory Management Memory Management Strategies: process address space static vs dynamic loading. Swapping, memory allocation; fragmentation, Paging, Segmentation and Virtual Memory.	06 Hrs
Unit-II	
Chapter No. 4: Introduction To Real-Time Operating Systems Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to the real-time embedded system- real-time systems, characteristics of real-time systems and the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling	08 Hrs
Chapter No. 5: Tasks, Semaphores and Message Queues: Task: Structure, Event Flags: Structure, uses, Semaphore: Structure, Types: binary semaphore, mutual exclusion (mutex) semaphore, and uses Message Queue: Structure, Uses. Priority Inversion problem and its solutions.	08 Hrs
Unit-III	
Chapter No. 6: Typical Embedded System and bus protocols: Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, AMBA Bus Protocol, SPI, RS 485, wireless protocols (Bluetooth, 802.11 and its variants, ZigBee)	08 Hrs
Chapter No. 7: Case study: Applications based on Cortex-M series in RTOS environment	02 Hrs
List of experiments **1.**Write a C program to use on chip Timers in LPC2148 and generate required delay	20 Hrs

2. Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS 3. Write a 'C' program & demonstrate concept of Round Robin Task Scheduling. 4. Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS 5. Write a 'C' program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS 6. Write a 'C' program & demonstrate concept of Mailbox. 7. Write a 'C' program & demonstrate concept of Semaphore. 8. Write a 'C' program & demonstrate concept of interrupts(hardware and software) 9. Write a C program to interface I2C-RTC with LPC2148. 10. Write a C program to interface SPI-EEPROM with LPC2148.	
Text Books **1.** Abraham Silberschatz, Galvin , Operating System concepts, 8th edition 2. Raj Kamal, Embedded Systems, 2nd edition 3. Shibu K V, Introduction to Embedded systems, 6th reprint, 2012	
Reference Books: Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1st edition	

Back

Program: Electrical & Electronics Engineering		**Semester: V**
Course Title: Digital Signal Processing		**Course Code: 20EEEC301**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Exam Duration: 3 Hrs**	

Unit-I	
Chapter No. 1. Discrete Fourier Transforms (DFT): Time and Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution. Additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.	08 Hrs
Chapter No. 2. Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms).. Radix-2 FFT algorithm for the computation of DFT and IDFT– decimation-in-time and decimation-in-frequency algorithms.	07 Hrs
Unit-II	
Chapter No. 3. IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.	08 Hrs
ChapterNo.4. FIR filter design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning and Bartlett windows.	07 Hrs
Unit-III	
Chapter No. 5: Structure for IIR and FIR Systems: Direct form, Cascade form, Parallel form structures. Linear Phase, Frequency sampling structure, Lattice structure	10 Hrs

Text Books:

1.John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing, Third Edition, Prentice-Hall of India Pvt

Reference Books:

1.J. F. James, A Students Guide to Fourier Transforms With Applications in Physics and Engineering, Third Edition

2.Sanjit K. Mitra, Digital Signal Processing- A computer based approach, Tata McGraw-Hill Publishing Company Limited, New Delhi

3.Alan V Oppenheim & Ronald W. Schfer, Discrete-Time Signal Processing, Prentice-Hall of India Pvt. Ltd

Back

Program: Electrical & Electronics Engineering		**Semester: V**
Course Title: Linear Integrated Circuits		**Course Code: 18EEEC301**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Exam Duration: 3 Hrs**	

Unit-I	
Chapter No. 1. Current Mirrors : Current Mirror circuits and Modeling, Figures of merit (output impedance, voltage swing), Widlar, Cascode and Wilson current Mirrors, Current source and current sink.	05 Hrs
Chapter No. 2. Basic OPAMP architecture : Basic differential amplifier, Common mode and difference mode gain, CMRR, 5-pack differential amplifier, 7-pack operational amplifier, Slew rate limitation, Instability and Compensation, Bandwidth and frequency response curve	06 Hrs
Chapter No. 3. OPAMP characteristics : Ideal and non-ideal OPAMP terminal characteristics, Input and output impedance, output Offset voltage, Small signal and Large signal bandwidth.	04 Hrs
Unit-II	
Chapter No. 4. OPAMP with Feedback : OPAMP under Positive and Negative feedback, Impact Negative feedback on linearity, Offset voltage, Bandwidth, Input and Output impedances, Follower property, Inversion property	05Hrs
Chapter No. 5. Linear applications of OPAMP : DC and AC Amplifiers, Voltage Follower, Summing, Scaling and Averaging amplifiers (Inverting, Non-inverting and Differential configuration), Integrator, Differentiator, , Current amplifiers, Instrumentation amplifier, Phase shifters, Voltage to current converter, Phase shift oscillator, Weinbridge oscillator, Active Filters –First and second order Low pass & High pass filters.	10 Hrs
Unit-III	
Chapter No. 6. Nonlinear applications of OPAMP : Crossing detectors (ZCD. Comparator), Schmitt trigger circuits, Monostable & Astable multivibrator, Triangular/rectangular wave generators, Waveform generator, Voltage controlled Oscillator, Precision rectifiers, Limiting circuits. Clamping circuits, Peak detectors, sample and hold circuits, Log and antilog amplifiers, Multiplier and divider Amplifiers, Voltage Regulators.	10 Hrs

Text Books:

1. Sedra and Smith, “Microelectronics”, 5 th edition, Oxford University Press.
2. Ramakant A. Gayakwad, “Op - Amps and Linear Integrated Circuits”, 4th edition, PHI.

Reference Books:

1. Robert. F. Coughlin & Fredrick F. Driscoll, “Operational Amplifiers and Linear Integrated Circuits Integrated Circuits”, PHI/Pearson, 2006.
2. James M. Fiore, “Op - Amps and Linear Integrated Circuits”, Thomson Learning, 2001.
3. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, TMH, 3e, 2005.
4. David A. Bell, “Operational Amplifiers and Linear IC’s”, 2nd edition, PHI/Pearson, 2004.

Back

Program: Electrical & Electronics Engineering		**V Semester**
Course Title: Machine Learning & Deep Learning		**Course Code: 24EEEC302**
L-T-P: 2-0-2	**Credits: 4**	**Contact Hrs: 6 Hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs + Lab.: 30+48	**Exam Duration: 2 Hrs**	

Unit I	
Chapter No.1 Introduction Motivation, History and Evolution, Definition (ETP, Examples), Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning.	03 Hrs
Chapter No. 2 Supervised Learning Model Representation: Basic Terminologies (Variable/features, Input, Output, Model, Learning Algorithm, Hypothesis, Cost/Loss function) Linear Regression: Single Variable (Representation of hypothesis, cost function, Optimization: Sum of squared error (L1 and L2), parameters/weights, bias) without bias and with bias. Model Optimization: Introducing Iterative optimization (Sum of squares error function, Gradient descent algorithm) and non-iterative optimization. Linear Regression: Polynomial Regression and Multi-variable Regression (Representation of hypothesis, cost function, Optimization).Model Optimization: Gradient descent algorithm (Learning rate/ step size, Normalization/ Feature Scaling).Model Optimization: Non-iterative optimization (Normal Equation).Logistic Regression: Hypothesis Representation, Decision boundary, Cost function, Logistic Regression: Optimization (Gradient Descent), Multi-class classification (One-vs.-all classification using logistic regression), Classical supervised learning algorithm- Support Vector Machine (SVM)	08 Hrs
Chapter No. 3 Performance Evaluation Performance Evaluation of learning models: Metrics (Confusion matrix, Precision, Recall, F1 Score, RoC curves), Modeling data and validating learning, Over fitting, Trade of Bias and Variance, Methods to overcome over fitting (Feature reduction, Regularization)	04 Hrs
Unit - II	
Chapter No. 4 Unsupervised Learning Clustering: Introduction, K-means Clustering, Algorithm, Cost function, Applications, Dimensionality Reduction: Motivation, Definition, Methods of Dimensionality reduction, Dimensionality Reduction: PCA- Principal Component Analysis	05 Hrs
Chapter No. 5 Introduction to Neural Network Introduction to Neural Networks (Motivation: non-linear model, Neurons and perception), Model representation: Neural Network Architecture (Activation units, Layers), Neural Network: Initialization, Forwards propagation, and Cost function, Back propagation algorithm, multi-class classification, Steps to train a neural network, Applications of Neural Networks	05 Hrs
Chapter No. 6 Introduction to Deep learning	05 Hrs

Introduction to Deep Learning (Motivation, Overview), Convolution Neural Networks (CNN) (Architecture, terminologies, Evolution and Modelling), Recurrent Neural Networks (RNN), Self-supervised models (Auto encoders and variants), Generative Models (GAN, its variants and applications), Attention networks, Transformer based architecture, Transformer for Time-Series	

Machine Learning/Deep Learning Lab Programs

1. Write a python code to Implement Linear Regression(Create Electrical dataset).
2. Write a python code to Implement Logistic regression.
3. Write a python code to Implement Classification (Create Electrical dataset).
4. Write a python code to Implement SVM.
5. Write a python code to Implement PCA.
6. Write a python code to Implement K means Clustering.
7. Write a python code to Implement 2 input NAND gate using Perceptron concept in NN.
8. Write a python code to Implement 3 input AND gate using Perceptron concept in NN.
9. Write a python code to Implement 2 input XOR gate using Perceptron concept in NN.
10. Python program to classify images using Convolutional Neural Network (CNN).
11. Python program to classify audios using Recurrent Neural Network (CNN).

Text Books:

1. Tom Mitchell, Machine Learning, 1, McGraw-Hill, 1997 Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007

References

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining Inference and Prediction, 2, Springer, 2009

Back

Program: Electrical & Electronics Engineering		Semester: V
Course Title: Machines lab		Course Code: 19EEEP301
L-T-P: 0-0-1	Credits: 1	Contact Hours: 2Hrs/week
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Laboratory Hours: 28	Examination Duration: 2 Hrs	
Demonstration		
Expt. No. 1 Star and Delta Connection of Lamps		
Expt. No. 2 Open circuit characteristics of DC machine		
Expt. No. 3 Speed control of separately excited DC motor by armature voltage control and flux control		
Expt. No. 4 Synchronization of Alternator with Bus bar/ Parallel operation of Alternator		
Exercise Experiments		
Expt. No.1 To Conduct NO – LOAD & BLOCKED ROTOR test on a given Induction motor to a) Find the performance parameters b) Represent the motor by its equivalent circuit model referred to Stator or Rotor.		
Expt. No. 2 To Conduct Open Circuit and Short Circuit test on given single phase transformer to a) Calculate efficiency and voltage regulation at different loads & power factors. b) Draw the transformer equivalent circuit model.		
Expt. No. 3 Load test on 3Ø Induction motor		
Expt. No. 4 Three phase Transformer bank using three single phase transformers with different configurations of primary and secondary windings.		
Expt. No. 5 Speed control of Induction motor by V/f method		
Expt. No. 6 Performance study of synchronous motor with change in its excitation (V and Inverted V curves)		
Expt. No. 7 Voltage regulation of an Alternator by EMF and MMF method		
Structured Enquiry		
Expt. No. 1 To develop the second order response surface methodology (RSM) based speed prediction model of DC shunt motor by conducting experiments as per Design of Experiments.(DOE)		

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Program: Electrical & Electronics Engineering		Semester: V
Course Title: Data Acquisition and Controls Lab		Course Code: 23EEEP302
L-T-P: 0-0-1	Credits: 1	Contact Hours: 2Hrs/week
CIE Marks: 80	SEE Marks: 20	Total Marks: 100
Laboratory Hours: 28	Examination Duration: 2 Hrs	
Demonstration Experiments		
Expt. No. 1. Demonstration of Basic Op-amp Circuits [Voltage Follower, Inverting and Non-inverting Op-amp]		
Exercise Experiments		
Expt. No. 1. Design and implementation of Rectifier Circuits (half wave and full wave rectifier)		
Expt. No. 2. Design and implementation of Wave shaping circuits (clippers and clampers) (Clampers- in PSPICE/any simulation tool)		
Expt. No. 3. Design and implementation of Filter circuits (Low Pass Filter and High Pass Filter)		
Expt. No. 4. Design and implementation of waveform generating circuits (Schmitt trigger and Zero Crossing Detector)		
Expt. No. 5. Design and simulation of Data converter circuits (R-2R D-A Converter using op-amp in PSPICE/any simulation tool)		
Expt. No. 6. Design and analyze time response specifications of second order system		
Expt. No. 7. Design and analyze frequency response specifications of second order system		
Expt. No. 8. Design and analyze Lag and Lead Compensators		
Structured Enquiry		
Expt. No. 1 Simulate and Investigate the effect of P, PI, PID controllers on the time response of a given second order series RLC system. (MATLAB/using any simulation tool)		

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Program: Electrical & Electronics Engineering		**Semester: V**
Course Title: Linear algebra and statistics		**Course Code: 15EMAB302**
L-T-P : 3-0-0	**Credits: 3**	**Contact Hrs:3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40	**Exam Duration: 3 hrs**	

Unit - I	
Chapter No. 1 Matrices and Linear Equations: Introduction, Geometry of Linear equations, Elementary operations, Systems in Echelon form, pivot and free variables, Gauss elimination , Application to electrical circuits	06 Hrs
Chapter No. 2 Vector spaces: Vector Spaces and Subspaces, Solving AX=0 and AX=B. Linear combination of vectors, spanning set, Linear independence, Basis and Dimensions, Column space, Row space and Null space	05 Hrs
Chapter No. 3 Orthogonality : Eigenvalues and Eigenvectors, Diagonalizing matrices	04 Hrs
Unit - II	
Chapter No. 4 Regression Introduction to method of least squares, fitting of curves: $\boldsymbol{y = a + bx}$,$\boldsymbol{y = a + bx + cx^2}$, $\boldsymbol{y = ab^x}$, correlation and regression. Engineering problems	05 Hrs
Chapter No. 5 Probability Definition of probability, conditional probability, Multiplication Rule, Baye's rule(No proof), Discrete and Continuous Random variables- PDF-CDF- Probability Distributions: Binomial, Poisson, Exponential and Normal (problems only)	10 Hrs
Unit - III	
Chapter No. 6 Random Process (a) Introduction to Joint Probability Distributions, marginal distribution, joint pdf and cdf, mean, variance, covariance, correlation. **(b)** Introduction to Random process, stationary process, mean, correlation and covariance function, autocorrelation function, cross correlation, Power spectral Density: properties of the spectral density; Gaussian Process: Properties of Gaussian process.	10 Hrs

Text Books:

1. Gilbert Strang, Linear Algebra and its Applications, 4ed, Thomson India Edition, 2007.
2. David C Lay, Linear Algebra and its Applications, 3ed, Pearson India, 2009
3. Gupta S C and Kapoor V K, Fundamentals of Mathematical Statistics, 9ed, Sultan Chand & Sons, New Delhi, 2002

Reference Books:

1. **J**. Susan Milton, Jesse C. Arnold, Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th Ed, TATA McGraw-Hill Edition 2007.
2. Schaum's Outline of Linear Algebra Seymour Lipschutz, Marc Lipson 4ed, McGraw Hill India 2009.

Back

Program: Electrical & Electronics Engineering		Semester: V	
Course Title: Arithmetical Thinking and Analytical Reasoning		Course Code: 22EHSH301	
L-T-P-: 0.5-0-0	Credits: 0.5	Contact Hrs: 16	
ISA Marks: 100	ESA Marks: 0	Total Marks: 100	
Teaching Hrs: 16	Exam Duration: N.A.		
Content			
Chapter No. 1. Analytical Thinking Importance of Sense of Analysis for Engineers, Corporate Methodology of Testing Sense of Analysis, Puzzles for practice: Analytical, Mathematical, Classification Puzzles, Teamwork in Problem Solving			04 Hrs
Chapter No. 2. Mathematical Thinking I Problems on Finance: Percentages, Gain and Loss, Interest; Distribution and Efficiency Problems: Averages, Time Work, Permutations Combinations			04 Hrs
Chapter No. 3. Mathematical Thinking II Distribution Problems: Permutations Combinations			02 Hrs
Chapter No. 4. Verbal Ability Comprehension of Passages, Error Detection and Correction Exercises, Common Verbal Ability questions from Corporate Recruitment Tests			06 Hrs
Reference Books: 1. George J Summers, "The Great Book of Puzzles & Teasers", Jaico Publishing House,1989 2. Shakuntala Devi , "Puzzles to Puzzle You", Orient Paper Backs, New Delhi, 1976 3. R. S. Aggarwal, "A Modern Approach to Logical Reasoning", Sultan Chand and Sons, New Delhi, 2018 4. M Tyra, "Magical Book on Quicker Maths", BSC Publications, 2018 5. Cambridge Advanced Learner's Dictionary, Cambridge University Press. 6. Kaplan's GRE guide			

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VI Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Sem: VI**
Course Title: Automotive Electronics		**Course Code: 24EEEC304**
L-T-P:2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/Week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hours: 24	**Lab Hours: 24**	**Exam Duration: 2 Hrs**

Unit - I	
Chapter No: 1. Automotive fundamentals and electronics Overview of automotive industry, vehicle functional domains, automotive mechanical systems,ECU design cycle: V and Agile.	2 Hrs
Chapter No: 2. Automotive Sensors and Actuators Sensor characteristics, wheel speed sensors, engine speed sensor, temperature sensor, mass air flow rate sensor, exhaust gas oxygen sensor, throttle plate angular position sensor, crankshaft angular position sensor, pressure sensors, fuel injection actuator, exhaust gas recirculation actuator.	3 Hrs
Chapter No: 3. Automotive Control Systems Design Introduction to control strategies, engine management system: engine mapping, catalytic converter, electronic engine control, fundamentals of electric vehicle, Drive cycles, EV drive train, EV Batteries, Types of EV: Micro-Hybrid, mild-hybrid, plug-in Hybrid.	4 Hrs
Unit - II	
Chapter No: 4. Vehicle safety and stability systems Active and passive safety systems: ABS, Traction Control, ESP, Electronics suspension system, intelligent cruise control, steering control systems and airbag.	3 Hrs
Chapter No: 5. Automotive communication protocols Overview of Automotive communication protocols, CAN, CAN FD, LIN, MOST.	6 Hrs
Chapter No: 6. ADAS and Vehicle Diagnostics Advanced Driver Assistance Systems (ADAS), Autonomous driving Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, Introduction to vehicle diagnostics, onboard/off board Diagnostics, diagnostic tools, diagnostic fault codes, diagnostic protocols: KWP2000 and UDS.	6 Hrs
Experiments List	
1. Modeling and simulation of Electrical/Mechanical/ Electronics subsystems using Simulink/Simscape. 2. Modeling seat belt warning system, and vehicle speed control based on the gear input using state flow and realization on the hardware platform. 3. Modeling and simulation of wiper control system using state flow and realization on the hardware platform. 4. Design and realization of car interior light control using Model Based Design 5. Modeling and simulation of EGAS system and realization on the hardware platform.	
Text Books: **1.** Ribbens, Understanding of Automotive electronics, 6th Edition, Elsevier, 2003	

2. Denton.T, Automobile Electrical and Electronic Systems, Elsevier, 3rd Edition, 2004
3. Konrad Reif Ed , Brakes, Brake Control and Driver Assistance Systems, Professional Automotive Information, Springer, 2014
4. David Smith, Kenneth Simpson, The Safety Critical Systems Handbook, 5th Edition, 2020

Reference Books:

1. Ronald K Jurgen, Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999
2. James D Halderman, Automotive electricity and Electronics, PHI Publication, 2000
3. Allan Bonnick, Automotive Computer Controlled Systems Diagnostic Tools and Techniques, Elsevier Science, 2001
4. Nicholas Navet , Automotive Embedded System Handbook , 2009

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Program: Electrical & Electronics Engineering		Semester : VI
Course Title: CMOS VLSI Circuits	**Course Code: 23EEEC304**	
L-T-P: 3-0-0	**Credits: 3**	**Contact Hrs: 3Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40	**Exam Duration: 3 Hrs**	

Unit – I	
Chapter No. 1. Introduction to VLSI and IC fabrication technology VLSI Design Flow, Semiconductor Technology - An Overview, Czochralski method of growing Silicon, Introduction to Unit Processes (Oxidation, Diffusion, Deposition, Ion-implantation), Basic CMOS technology - Silicon gate process, n-Well process, p-Well process, Twin-tub Process, Oxide isolation.	06 Hrs
Chapter No. 2. Electronic Analysis of CMOS logic gates DC transfer characteristics of CMOS inverter, Beta Ratio Effects, Noise Margin , Transient Analysis of CMOS Inverter, NAND gate , Switch-level RC Delay Models, Delay Estimation, Elmore Delay Model, Power Dissipation of CMOS Inverter, Transmission Gates & Pass Transistors, Tristate Inverter.	12 Hrs
Unit – II	
Chapter No. 3. Design of CMOS logic gates Stick Diagrams, Euler Path, Layout design rules, DRC, Circuit extraction, Latch up – Triggering Prevention.	06 Hrs
Chapter No. 4. Designing Combinational Logic Networks Gate Delays, Pseudo nMOS, Clocked CMOS, Dynamic CMOS Logic Circuits, Dual-rail Logic Networks: CVSL, CPL.	08 Hrs
Unit - III	
Chapter No. 5. Sequential CMOS Circuit Design Sequencing methods, Max-Delay Constraints, Min- Delay Constraints, Conventional CMOS latches, Conventional CMOS Flip-Flops, True Single-phase-clock (TSPC) Latches and Flip – flops ,Clock generation and Clock distribution	08 Hrs

Text Books (List of books as mentioned in the approved syllabus)

1. John P. Uyemura, Introduction to VLSI Circuits and Systems, 1, Wiley, 2007
2. Neil Weste, David Harris & Ayan Banerjee, CMOS VLSI Design, 3, Pearson Ed, 2005
3. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3, Tata McGraw Hill, 2007

Reference Books

1. Wayne, Wolf, Modern VLSI design: System on Silicon, 3, Pearson Ed, 2005
2. Douglas A Pucknell and Kamran Eshraghian, Basic VLSI Design, 3, PHI, 2005
3. Phillip. E. Allen, Douglas R. Holberg, CMOS Analog circuit Design, 1, Oxford University, 2002

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Program: Electrical & Electronics Engineering		Semester : VI
Course Title: Generative AI	Course Code: 24EEEC305	
L-T-P: 2-0-1	Credits: 3	Contact Hrs: 4Hrs/Week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hrs: 56 (28-28)	Exam Duration: 2 Hrs	

Unit – I	
Chapter 1: Introduction to Generative AI Definition, Overview of Generative AI, Importance and applications of Generative AI, Evolution of AI towards generative models, Key milestones and breakthroughs in Generative AI.	02 Hrs
Chapter 2: Generative AI Models : Autoencoders (AE) and Variational Autoencoders (VAEs) Architecture: Encoder, Decoder, Latent Space, Training with ELBO (Evidence Lower Bound), Applications and limitations. Generative Adversarial Networks (GANs): Architecture: Generator and Discriminator, Training process, loss functions, Common issues, Variants: DCGAN, CycleGAN, StyleGAN. Diffusion Models: Forward process (encoders), reverse process (decoders), score matching, guided diffusion	04 Hrs
Chapter 3: Training and Evaluation of Generative AI Models: Optimization Methods: Gradient Descent, Stochastic Gradient Descent (SGD), Adam Optimizer, Adam (Adaptive Moment Estimation), RMSProp (Root Mean Square Propagation), Adagrad (Adaptive Gradient Algorithm), AdaDelta. Evaluation Metrics: Inception Score (IS), Frechet Inception Distance (FID), Perplexity, Reconstruction Error, Mode Score, Diversity Metrics, Wasserstein Distance, Earth Mover's Distance (EMD), BLEU Score, Challenges: Mode collapse, stability, and convergence.	04 Hrs
Chapter 4: Generative Models II: Autoregressive Models Definition and Principle: Autoregressive Property, Conditional Dependence, Autoregressive Process Examples of Autoregressive Models: AR Models in Time Series Analysis, Autoregressive Integrated Moving Average (ARIMA) Autoregressive Models for Generative AI: (PixelCNN, WaveNet)- Overview, Architecture, Training, Applications	04 Hrs
Unit – II	
Chapter 5: Generative Models II: Transformers Introduction to Transformers, Origins and evolution from traditional sequence models (like RNNs and LSTMs) to transformers, self-attention mechanism, multi-head attention, position-wise feedforward networks. Transformer Architecture: breakdown of encoder and decoder stacks, Layer normalization and residual connections, Masked self-attention in the decoder for auto-regressive generation, Pre-training and Fine-tuning. Transformer-based Autoregressive Models: GPT (Generative Pre-trained Transformer), Overview, Architecture, Training, Applications, BERT (Bidirectional	05 Hrs

Encoder Representations from Transformers), T5 (Text-to-Text Transfer Transformer)	
Chapter 6: Generative Models II: Large Language Models (LLMs) Introduction to LLMs, Overview of Large Language Models (e.g., GPT-3, GPT-4) Training methodologies and scalability, Integration of LLMs in various generative tasks, Fine-tuning and transfer learning with LLMs, Building and deploying LLM-based applications.	05 Hrs
Chapter 7: Ethical Considerations and Responsible AI: Bias and fairness in generative AI models, Privacy concerns and data protection in generative AI applications, Responsible use of generative models in society	04 Hrs

Text Books :

1. Christopher M. Bishop, Hugh Bishop, “Deep Learning - Foundations and Concepts”, Springer 2024, ISBN 978-3-031-45467-7, pp. 1-607.
2. Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni, Dilip Gudivada, “Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models, ChatGPT, and Other LLMs”, 978-1-4842-9994-4, (2023), https://doi.org/10.1007/978-1-4842-9994-4.
3. Martin Musiol, “Generative AI: Navigating the Course to the Artificial General Intelligence Future”. John Wiley & Sons Inc; 1st edition, (2024), ISBN-13: 978-1394205912, 1-288 pages.
4. Jospeh Babcock and Raghav Bali, “Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models”, Packt Publishing (2021); Packt Publishing Limited, 1-488 Pages, ISBN-13: 978-1800200883

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Program: Electrical & Electronics Engineering		Semester: VI
Course Title: CMOS VLSI Circuits Laboratory		Course Code: 23EEEP304
L-T-P : 0-0-1	Credits: 1	Contact Hours:2Hrs/week
ISA:80	ESA:20	Total Marks :100
Laboratory Hours : 24	Exam Duration:2Hrs	
Demonstration Experiment **Expt No.1 Introduction to Cadence EDA tool.**		
Exercise Experiments		
Expt No.2 MOSFET Device characteristic.		
Expt No.3 Static and Dynamic Characteristic of CMOS inverter.		
Expt No.4. Static and Dynamic Characteristic of CMOS NAND2 and NOR2.		
Expt No.5. Layout of CMOS Inverter (DRC,LVS)		
Expt No.6. Layout of NAND2, NOR2, XOR2 gates (DRC, LVS).		
Structured Enquiry 1. AOI, OAI circuits and analyze the performance with optimized layout using Cadence tool.		
Open Ended Experiments 1. Design complex combinational circuits and analyze the performance using Cadence tool.		
Text Books: 1. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, Wiley. 2. Neil Weste and K. Eshragian,”Principles of CMOS VLSI Design: A System Perspective,” 2nd edition, Pearson Education (Asia) Ptv. Ltd., 2000		

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Program: Electrical & Electronics Engineering		Semester: VI	
Course Title: Industry Readiness & Leadership Skills		Course Code: 23EHSA304	
L-T-P : 0-0-0	Credits: 00	Contact Hrs: 16	
ISA Marks: 100	ESA Marks: 0	Total Marks: 100	
Teaching Hrs: 16		Exam Duration: N.A.	
Content			
Chapter No. 1. Written Communication Successful Job Applications, Résumé Writing, Emails, Letters, Business Communication, Essay, and Paragraph Writing for Recruitment Tests			06 Hrs
Chapter No. 2. Interview Handling Skills Understanding Interviewer Psychology, Common Questions in HR Interviews, Grooming, Interview Etiquette			04 Hrs
Chapter No. 3. Lateral & Creative Thinking Lateral Thinking by Edward de Bono, Fractionation and Brain Storming, Mind Maps, Creativity Enhancement through Activities			04 Hrs
Chapter No. 4. Team Building & Leadership Skills Communication in a Team, Leadership Styles, Playing a Team member, Belbin's team roles, Ethics, Effective Leadership Strategies			02 Hrs
Reference Books: 1. Diana Booher – E Writing, Laxmi Publications 2. Edward de Bono–Lateral Thinking – A Textbook of Creativity, Penguin UK 3. William Strunk, E B White – The Elements of Style, Pearson 4. John Maxwell – The 17 Essential Qualities of a Team Player, HarperCollins Leadership 5. Robin Ryan – 60 Seconds and You're Hired! – Penguin Books			

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Program: Electrical & Electronics Engineering		**Semester: VI**	
Course Title: Professional Aptitude and Logical Reasoning		**Course Code: 16EHSC301**	
L-T-P : 3-0-0	**Credits: 3**	**Contact Hrs: 3Hrs/week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hrs: 40	**Exam Duration: 3 Hrs**		
Unit –I - Arithmetical Reasoning and Analytical Thinking			
Chapter No. 1. – Arithmetical Reasoning			10 Hrs
Chapter No. 2. – Analytical Thinking			04 Hrs
Chapter No. 3. – Syllogistic Logic			03 Hrs
Unit – II – Verbal and Non – Verbal Logic			
Chapter No. 1. – Verbal Logic			09 Hrs
Chapter No. 2. – Non-Verbal Logic			06 Hrs
Unit – III - Lateral Thinking			
Chapter No. 1. - Lateral Thinking			08 Hrs

Text Books:

1. A Modern Approach to Verbal and Non – Verbal Reasoning – R. S. Aggarwal, Sultan Chand and Sons, New Delhi
2. Quantitative Aptitude – R. S. Aggarwal, Sultan Chand and Sons, New Delhi

Reference Books:

1. Verbal and Non – Verbal Reasoning – Dr. Ravi Chopra, MacMillan India
2. Lateral Thinking – Dr. Edward De Bono, Penguin Books, New Delhi

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VII Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: Electrical & Electronics Engineering		**Sem: VII**	
Course Title: Power System Modelling, Operation & Control		**Course Code: 25EEEC401**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hrs: 4 Hrs/Week**	
ISA: 67	**ESA: 33**	**Total Marks: 100**	
Teaching Hrs: 24	**Lab Hrs: 24**	**Exam Duration: 2Hrs**	
Unit – I			
Chapter No. 1. Formation of Network Matrices Multi-port power system representation, performance equations in bus frame of reference, definitions of Network models Ybus and Zbus, Primitive element representations, primitive performance equations,. Formation of Ybus by method of Inspection, Introduction to graph theory- definitions of terms, Bus incidence matrix, Ybus by the method of singular transformation, Examples on Ybus formation by singular transformation (with no mutual coupling) and Inspection method, Zbus building algorithm-addition of uncoupled branches and links, modification of Zbus for changes in elements not mutually coupled, Examples on Zbus formation			06hrs
Chapter No. 2. Optimal Load Dispatch Importance and objective of economic load dispatch, Fuel cost and Incremental fuel cost, Optimal load allocation between plants neglecting transmission losses, Examples on optimal load allocation with and without generation constraints, Optimal load allocation considering transmission losses, General transmission loss formula, Examples.			06 hrs
Unit – II			
Chapter No. 3. Load Flow Analysis Importance of Power flow, Classification of busses, General steps in load flow analysis, Off-nominal ratio tap changing ratio transformer representation. Bus voltage solution by Gauss and Gauss-Seidel methods without PV buses, Handling PV buses in Gauss-Seidel method, N-R load flow model in polar coordinates, formation of NR Jacobian, Introduction to FDLF load flow model, Comparison of Gauss-Seidel, NR and FDLF load flow methods, Examples on one iteration of load flow solution.			06 hrs
Chapter No. 4. Load frequency control Introduction to load frequency control problem, Working principle of speed governor, Model of isolated power system area –block diagram representation, Expression for steady-state frequency deviation, Parallel operation of generators –expression for operating frequency and load sharing,, two area load frequency control, steady-state operation of multi-area system under free governor operation, Examples on load sharing between areas.			06 hrs
Lab Experiments to be conducted			
1. Formation Ybus bysingular transformation			02 Hrs
2. To form Ybus by themethod of inspection			02 Hrs
3. Solution of load flow problem using Gauss-Seidel method			02 Hrs
4. Solution of load flow problem using Newton-Raphson method.			02 Hrs
5. Economic load dispatch without considering network losses			02 Hrs

6. Economic load dispatch considering network losses	02 Hrs
7. ABCD Line parametersand line performance	02 Hrs
8. Solution of swing equation	02 Hrs
9. Load frequency control problem	02 Hrs
Structured Enquiry	
1.Develop and Analyzepower system solution using GUI based power system software package/developprograms, carry outsimulations of aspecified problem of alarge-scale interconnected powersystem, interpret theresults of the simulation,draw practical conclusions from themand prepare a technical report	06 Hrs

Text Books:

1. Stagg and El-Abid, Computer Methods in power system analysis, First, Mc-Graw Hill, 1968
2. Kothari and Nagarath, Modern Power System Analysis, 3, TMH, 2004

Reference Books:

1. P Kundur, Power system stability and control, 1st ed, TMH, 2007
2. Hadi Sadat, Power system analysis, 1st ed, TMH, 2002
3. A.R. Bergen and Vijay Vittal, Power System Analysis, First, Pearson Education, 2009 Joe H. Chow, Juan J. Sanchez-Gasca, Power System Modelling, Computation

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Program : Electrical & Electronics Engineering		Semester: VII
Laboratory Title: Relay and High Voltage Engineering lab		Course Code:24EEEP401
L-T-P: 0-0-1	Credits: 1	Contact Hours:4Hrs
ISA Marks:80	ESA Marks:20	Total Marks:100
Teaching Hours:24	Exam Duration: 2Hrs	
Exercise Experiment		
Expt. No.1 Introduction Session		
Expt. No.2 To obtain the inverse time characteristics of a given fuse wire and wires of different lengths.		
Expt. No.3 To obtain the inverse time characteristics of an electromagnetic over current relay		
Expt. No.4 To obtain the operating characteristics of microprocessor based differential relay.		
Expt. No.5 To obtain the operating characteristics of microprocessor based directional over current relay.		
Expt. No.6 To obtain the breakdown strength of air using Copper sphere gap with HVAC and HVDC.		
Expt. No.7 a) To obtain the breakdown strength of air using different pairs of electrode gap with HVAC and HVDC. b) To obtain the breakdown voltage of a solid dielectric. c) To obtain the breakdown voltage of a liquid dielectric.		
Structured Enquiry		
To develop microcontroller based overcurrent, over voltage and impedance relay using CT /PT giving details of program and demonstrate it's working output.		

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Program Electives

(E-Mobility)

Program: Electrical & Electronics Engineering		Sem: VI
Course Title: Electric Vehicular Technology		Course Code: 24EEEE301
L-T-P: 1-0-2	Credits: 3	Contact Hrs: 5 Hrs/Week
ISA: 67	ESA: 33	Total Marks: 100
Teaching Hrs: 27	Lab Hrs: 43	Exam Duration: 2Hrs

Unit-I	Hrs
Chapter No. 1. Introduction to Electric Vehicles History of Electric Vehicles, Types of EVs: Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs), and Hybrid Electric Vehicles (HEVs), Advantages and Challenges of EVs.	02 Hrs
Chapter No. 2. EV Components and Architecture EV Architecture, Electric Vehicle Motors, Batteries: Types, Lithium-ion, Solid-State, and Capacities, Converters, and Controllers, Charging Infrastructure: Onboard Chargers, Offboard Chargers, and Charging Standards	05 Hrs
Chapter No. 3. Batteries and Energy Storage Systems Battery Design and Manufacturing Process, Energy Density, Cycle Life, and Charging Efficiency, Battery Management Systems (BMS), State estimations, Battery Recycling.	05 Hrs
Unit-II	
Chapter No. 4. Charging Systems and Infrastructure Types of EV Chargers (Level 1, Level 2, and DC Fast Charging), Charging Standards and Protocols (CHAdeMO, CCS, Tesla Superchargers) Wireless Charging Systems, Smart Charging and Grid Integration, Infrastructure Development and Urban Planning for EVs.	05 Hrs
Chapter No. 5. Electric Motors and Powertrain Technology Principles of Electric Motors, Types of Electric Motors Used in EVs, EV transmission Systems, Regenerative Braking Systems, Thermal Management in Powertrains.	05 Hrs
Chapter No. 6. Control Systems and Power Electronics in Electric Vehicles Power Electronics Overview, Vehicle Control Units (VCUs), Software and Communication Protocols (CAN Bus, IoT in EVs), Role of AI and ML in EV optimization, Introduction to autonomous EV technology.	05 Hrs
Text Books (List of books as mentioned in the approved syllabus): 1. Electric Vehicle Technology Explained by James Larminie and John Lowry, A John Wiley & Sons, Ltd., Publication, 2nd Edition, 2012. 2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 3rd Edition, CRC Press, Taylor and Francis Group, 2021	
References: 1. Modern Electric, Hybrid Electric, and Fuel Cells Vehicles, Fundamentals, Theory and Design, 2nd Edition, Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, Taylor and Francis Group, 2018	

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Program: Electrical & Electronics Engineering		VII Semester	
Course Title: Battery Management Systems		Course Code: 25EEEE401	
L-T-P: 1-0-2	Credits: 3	Contact Hrs: 5 Hrs/Week	
ISA Marks: 67	ESA Marks: 33	Total Marks: 100	
Teaching Hrs: 27	Lab Hrs: 43	Exam Duration: 2 Hrs	
Unit – I			
Chapter No. 1. Introduction: Overview of cells and Batteries, Types of batteries, Battery Operation, Battery Construction, Battery Chemistry, Battery Models.			02 hrs
Chapter No. 2. Battery Models: Battery Models, Self-Discharge Model, Equivalent Circuits, Coulombic Efficiency, parameter identification using SOC/OCV.			02 hrs
Chapter No. 3. BMS (Black-box approach): Need for BMS, BMS inputs and outputs and functions Battery management system with an EV application			02 hrs
Chapter No. 4. BMS Architectures: Monolithic, Distributed, Semi-Distributed, Connection Methods, Additional Scalability, Battery Pack Architectures.			03 hrs
Chapter No. 5. System Control: Contactor Control, Soft Start or Precharge Circuits, Control Topologies, Contactor Opening Transients, Chatter Detection, Economizers, Contactor Topologies, Contactor Fault Detection.			04 hrs
Unit – II			
Chapter No. 6. Data acquisition (Measurement): Cell voltage, current and temperature measurement, Synchronization of Current and Voltage.			03 hrs
Chapter No. 7. Battery Management System Functionalities: CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, and Operational Modes.			03 hrs
Chapter No. 8. Charge Balancing (Cell balancing): Charge Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying capacitor.			04 hrs
Chapter No. 9. SoC Estimation: Columb counting, SoC corrections, OCV measurements, temperature compensation.			04 hrs

Text Books:

1. Phillip Weicker “A Systems Approach to Lithium-Ion Battery Management” 2013, Artech house publisher.
2. Gregory L. Plett “Battery Management Systems, Volume II, Equivalent-Circuit Methods” 2016.

Reference Books:

1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and Applications of Lithium-Ion Batteries in Electric Drive Vehicles”, John Wiley & Sons, 2015.

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Program: Electrical & Electronics Engineering		**Semester : VII**	
Course Title: Traction Systems for Electric Vehicles		**Course Code: 20EEEE401**	
L-T-P: 2-0-1	**Credits: 3**	**Contact Hrs: 4 Hrs/ Week**	
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**	
Teaching Hrs: 40		**Exam Duration: 2 Hrs**	
Unit – I			
Chapter No. 1. Motion and Dynamics Equations for Vehicles Introduction to hybrid and electric vehicles, dynamics of hybrid and electric vehicles, motion and dynamic equations for hybrid and electric vehicles.			04 hrs
Chapter No. 2. Basic Architecture of Electric Drive Trains: Electric vehicle configuration, EV alternatives based on drivetrains, EV alternatives based on power source configuration, single and multi-motor drives in wheel drives.			04 hrs
Unit – II			
Chapter No. 3. Modelling and Operation of VSI fed PMSM: Need for 3 phase to 2 phase transformation and 2 phase to three phase transformation, stator modeling, rotor modeling and torque equation, PMSM modelling, operation of PMSM supplied by inverter with 120° degree mode of operation, operation of PMSM supplied by inverter with 180° mode of operation, inverter fed PMSM.			08 hrs
Unit – III			
Chapter No. 4. Control of PMSM Control strategies of PMSM, constant torque angle control, constant mutual air gap flux linkage control, optimum torque per ampere control.			04 hrs
Chapter No. 5. Drive cycle analysis and sizing of electric machines for EVs and HEVs: Power train and drive cycles, New York City Cycle (NYCC), Federal Test Procedure (FTP 75), sizing of electric machine, peak torque and peak power, constant power speed ratio, EM sizing, sizing of power electronics.			04 hrs
Lab Experiments to be conducted			
1. Motion and Dynamic Equation and estimation of acceleration time of an EV.			02 Hrs
2. Simulation of non-isolated Buck, Boost and Buck-Boost DC-DC converters using MATLAB/Simulink or PLECS			04 Hrs
3. Multi-quadrant and Multi-input DC-DC converters for EV applications.			04 Hrs
4. Single and three phase voltage source inverters with PWM techniques			02 Hrs
5. Simulation of PMSMs fed with three phase supply voltages			02 Hrs
6. Simulation of VSI fed PMSMs			04 Hrs
Structured Enquiry			
7. Develop and analyze the given control strategy for a PMSM drive and interpret the results of the simulation, draw practical conclusions from them and prepare a technical report.			06 Hrs

Text Books:

1. NPTEL course notes on “Introduction to Hybrid and Electric Vehicles” , IIT Guwahati.
2. Chris Mi and M Abul Masrur, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2018.

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Program: Electrical & Electronics Engineering		Semester : VII
Course Title: Powertrain Control System Design		Course Code: 25EEEE402
L-T-P: 1-0-2	Credits: 3	Contact Hrs: 5 Hrs/Week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hrs.: 16	Lab Hrs.: 48	Exam Duration: 2 Hrs

Unit -I	
Chapter No. 1. Transformation Theory Introduction to RLC circuit, Mathematical modelling of three phase VSI, DQ-transformation theory, Harmonics impact on transformation.	02 Hrs
Chapter No. 2. EV Motor Modelling Mathematical modelling of PMSM and PMDC: Define motor parameters, Derive PMSM equations in DQ reference frame, Implement Clarke and Park transformations.	03 Hrs
Chapter No. 3. Control Strategies of EV Introduction of different control strategies, scalar control and vector control, Direct and indirect FOC, DTC: Define motor parameters (PMSM or BLDC), Perform Clarke and Park transformations, Measure or estimate rotor position and speed, Generate current references (id, iq), Design PI controllers for current loops, Inverse Park transformation to get three-phase voltages, Generate PWM signals using SVPWM or Sine PWM.	03 Hrs
Unit-II	
Chapter No. 4 Non-Isolated DC-DC Converters: Principle of operation, analysis of step-down and step-up converters, classification of PWM choppers, Analysis of two and four quadrant PWM choppers, and Sépic converters.	03 Hrs
Chapter No. 5 Isolated DC-DC Converters Principle of operation, analysis of step-down and step-up converters, Flyback Converter, Forward Converter, Half Bridge and Full Bridge Converter.	03 Hrs
Chapter No. 6. Dual Active Bridge Converters Basic principles and configurations of Dual Active Bridge (DAB) converters.	02 Hrs

Text Books (List of books as mentioned in the approved syllabus):

1. Ned Mohan, Advanced Electric Drives Analyses, control and Modelling using MATLAB Simulink, Johan Wiley & sons, Inc. Publications, Hoboken, New Jersey.
2. Sang-Hoon Kim, Electric Motor Control, November 2016.
3. Daniel W Hart, Power Electronics, Second Edition, Tata McGraw-Hill, 2017.
4. Rashid M. H, Power Electronics Circuits, Devices and Applications, 4th Edition, PHI, New Delhi, 2000.
5. P. S. Bhimbra, Power Electronics, 7th Edition, Khanna Publishers, 2022.
6. L. Umanand, Power Electronics: Essentials and Applications, 2nd Edition, Wiley-India Publications, New Delhi, 2009.

References:

1. Ned Mohan, Tore. M. Undeland and William. P Robbins, Power Electronics: Converters, Applications and Design, John Wiley and Sons, 2003.
2. Marian P. Kazmierkowski, R. Krishnan and Frede Blaabjerg, Control in Power Electronics, Academic Press, 2002.

3. Marian K. Kazimierczuk, Pulse-width Modulated DC–DC Power Converters, John Wiley & Sons.
4. Robert W. Erickson, Fundamentals of Power Electronics, Kluwer Academic Publishers, 2000.

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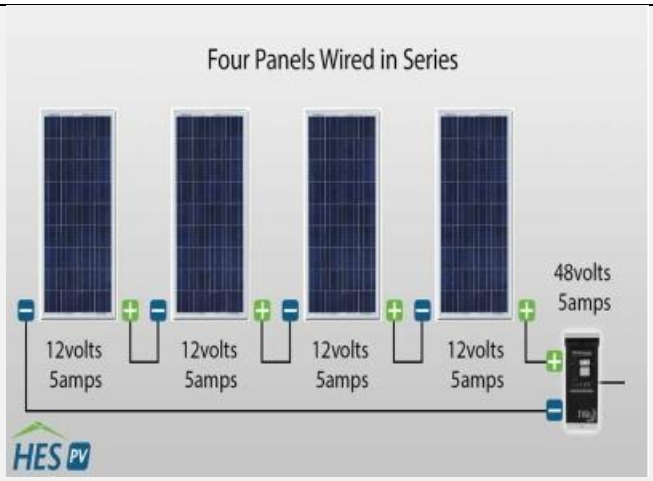
(Modern Power & Energy Systems)

Program: Electrical & Electronics Engineering		**Semester: VI**
Course Title: Modelling & Analysis of Hybrid Electrical Energy Systems		**Course Code: 24EEEE302**
L-T-P : 2-0-1	**Credits: 3**	**Contact Hrs: 4Hrs/Week**
ISA: 67	**ESA: 33**	**Total Marks: 100**
Teaching Hrs: 24	**Lab Hrs: 24**	

Unit-I	
Chapter No. 1. Introduction to PV Systems Introduction to PV Systems, Cell module and Panel, Irradiance Modeling, Series and Parallel connection, Characteristic curves, Classification of PV systems, System Pre-Sizing, Feasibility of Photo voltaic Systems, Maintenance of Photo voltaic Systems, PV array modelling	06 hrs
Chapter No. 2. Introduction to WECS Introduction WECS, Classification. Global Structure of WECS, Wind speed, Introduction to Wind Systems, Control Techniques, Wind power expression. Types of Wind power generation, Standalone with/ without storage, grid integrated WECS, Sizing of Wind turbine, Maintenance of Wind Systems, Total Costs for Wind Turbine Installation, Onshore and Offshore, Wind distribution models, Wind generators, Fixed speed/ variable speed SCRIG, DSIM, DFIG	06 hrs
Unit-II	
Chapter No. 3. Optimization of PV & WECS Introduction to Optimization of PV systems, Maximum power point tracking, P&O and Modified P&O algorithm, Incremental conductance algorithm, Hill climbing control Optimization algorithms for WECS, P&O Technique , Tip Speed Ratio Method, Power Signal Feedback (PSF) Method, Comparison of Different Algorithms PV/ WECS MPPT algorithms	06 hrs
Chapter No. 4. Hybrid Energy Systems and Grid integration issues Basic knowledge of Hybrid Energy Systems, Need for Hybrid systems, Configuration of Hybrid Systems, Combination of PV/ Wind/ Diesel generator Hybrid systems Grid Issues in integrating renewable energy systems, Types of Grid integration issues, Issues Related to Grid Integration of Small Scale Generation	06 hrs
Course Project(30 marks) Phase 1 (10 Marks) : Model using any suitable simulation software like MATLAB/ PYTHON/ any suitable. Design four panels of 12V 5 Amp each and connects them in series and parallel as shown. Simulate and verify the operation at various insolation levels.	



Case 1: Refer input irradiance table, Temp at 250 constant

Time	Irradiance in W/m2	Time	Irradiance in W/m2
7am	0	12.30 pm	1000
7.30 am	100	1 pm	900
8 am	200	1.30 pm	800
8.30 am	300	2 pm	700
9 am	400	2.30 pm	600
9.30 am	500	3 pm	500
10 am	600	3.30 pm	400
10.30 am	700	4 pm	300
11 am	800	4.30 pm	200
11.30 am	900	5 pm	100
12 am	1000	5.30 pm	0

Case 2: Constant irradiance as 1000 W/m2, Variable Temperature as 00,200, 400, 500 and 600

Phase II (10 Marks) : For the PV panel given in the table. Design and select a suitable converter and generate necessary plots and waveforms

Table 2.1 Parameter of the PV panel Siemens SM110-24 [31]

Parameter	Value
P_{mpp}	110 W
I_{mpp}	3.15 A
V_{mpp}	35 V
I_{sc}	3.45 A
V_{oc}	43.5 V
α_{sc}	1.4 mA/°C
β_{oc}	−152 mV/°C

Phase III (10 Marks) : Select suitable MPPT algorithm (PERTURB & OBSERVE MPPT ALGORITHM). Compare the output with and without MPPT algorithm. And draw necessary waveforms

- **Submit a detailed report not less than eight pages, include program/ simulation and all necessary waveforms.**
  Compare Efficiency with and without MPPT algorithm in a table

Text Books:

1. **Djamila Rekioua Ernest Matagne, Optimization of Photovoltaic Power Systems Modeling, Simulation and Control, Green Energy and Technology, Springer, 2014**
2. **Djamila Rekioua Ernest Matagne, Wind Power Electric Systems- Modeling, Simulation and Control, Green Energy and Technology, Springer, 2014**
3. **S. Sumathi ,L. Ashok Kumar , P. Surekha , Solar PV and Wind Energy Conversion Systems -An Introduction to Theory, Modeling with MATLAB/SIMULINK, Green Energy and Technology, Springer, 2014**

Reference Books:

1. **Gilbert M Masters, Renewable and Efficient Electric Power Systems, Wiley Interscience, New Jersey, 2004**

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Program: Electrical & Electronics Engineering		Semester: VII
Course Title: Smart Grid Technologies		Course Code: 25EEEE401
L-T-P: 1-0-2	Credits: 3	Contact Hrs:5 Hrs/Week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hrs: 27+43	Exam Duration: 2 Hrs	

Unit - I	
Chapter No. 1. Introduction to Smart grid technologies Challenges in Smart grids implementation: Communication challenges in smart grids, Overview of the technologies required for energy efficient smart grids, Threat and Impacts	02 hrs
Chapter No. 2. Communication technology in smart grids Communication Technologies, Distribution Generation and Active Control, Overview of smart grid communication standards, Integration of Utility, Cyber security, Interoperability, Case Studies.	05 hrs
Chapter No. 3. Smart Distribution systems and Energy Storage Smart metering, Real time pricing, Distributed Energy Resources in Smart Grids, Demand response, Plug in hybrid electric vehicles, Ultra capacitors, Fly wheels and Fuel cells	05 hrs
Unit - II	
Chapter No. 4. Renewable Energy integration Introduction of Block Chain and Digital twin in Smart grid integration, Integration of Intelligent Electronic Devices in EMS, Substation Automation, Carbon foot printing, Issues of interconnection, Protection and control of Micro-grid.	05 hrs
Chapter No. 5. Smart and Efficient Transmission System Transmission Blackouts: Risk, Causes and Mitigation and Case Studies, Phasor data concentrators, Energy Monitoring systems and its applications in Smart grids.	05 hrs
Chapter No. 6. Strategies for the future Energy efficient Electrical Networks BEE standards and Energy Management System, Demand forecasting, Prediction methods for secure power system operation, Market integration of the consumers.	05 hrs

Text Books :

1. Electric Vehicle Technology Explained by James Larminie and John Lowry, A John Wiley & Sons, Ltd., Publication, 2nd Edition, 2012.
2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 3rd Edition, CRC Press, Taylor and Francis Group, 2021

Reference Books:

1. Modern Electric, Hybrid Electric, and Fuel Cells Vehicles, Fundamentals, Theory and Design, 2nd Edition, Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, Taylor and Francis Group, 2018

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Program: Electrical & Electronics Engineering		Semester: VII	
Course Title: Flexible AC Transmission System (FACTS)		Course Code: 19EEEE401	
L-T-P: 3-0-0	Credits: 3	Contact Hours:3 Hrs/Week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours: 40	Exam Duration: 3 Hrs		
Unit - I			
Chapter No. 1 FACTS: Concept and General System Considerations: Transmission Interconnection, Flow of power in AC system, Limits of loading capability, Power flow and dynamic stability consideration of a Transmission Interconnection, Relative importance of controllable parameters, and Basic types of FACTS controllers, Brief description and Definitions of FACTS controllers, Perspective: HVDC or FACTS			10 Hrs
Chapter No. 2 Voltage Sourced Converters: Basic Concepts, Single Phase Full Wave Bridge Converter Operation, Single phase Leg operation, Three Phase Full Wave Bridge Converter, Transformer Connection for 12 pulse operation			05 Hrs
UNIT II			
Chapter No. 3 Current Sourced Converters: Basic concepts, Three phase full wave diode rectifier, Thyristor based converter Rectifier operation with gate turn ON, Current sourced converter with turn OFF devices, Current sourced versus Voltage sourced converter.			05 Hrs
Chapter No. 4 Objectives of Series and Shunt Compensation: Objective of Shunt Compensation, Methods of Controllable VAR Generation, Static VAR Compensators SVC STATCOM, Objective of Series Compensation, Static Series Compensators, GCSC, TSSC, TCSC and SSSC			10 Hrs
Unit – III			
Chapter No. 5 Static Voltage, Phase Angle Regulators: Objectives of Static Voltage and Phase Angle Regulators, Approach to Thyristor Controlled Voltage and Phase Angle Regulators, TCVR and TCPAR			05Hrs
Chapter No. 6 Combined Compensators: Unified Power Flow Controller UPFC and Interline Power Flow Controller IPFC.			05Hrs
Text Books: **1**. Narain G. Hingorani, and Laszlo Gyugyi., "*Understanding FACTS*", IEEE Press, Standard Publishers Distributors, Delhi, 200, ISBN 81 86308 79 2.			
References Books: **1.** K. R Padiyar, "*FACTS controllers in Power Transmission and Distribution",* New Age International Publishers, New-Delhi, 2007, ISBN 978 81 224 2142 2.			

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Program: Electrical & Electronics Engineering		Semester: VII
Course Title: Nonlinear Control Systems		Course Code: 25EEEE409
L-T-P: 3-0-0	Credits: 3	Contact Hrs: 3 Hrs/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Content	
Unit - I	
Chapter 01. Introduction to Non-linear system: Definition, Fundamental characteristics of noon-linear systems (Amplitude dependency, frequency-amplitude dependency, limit cycles, sub harmonic oscillations, frequency entrainment and jump resonance) Common physical non linearity (saturation, dead zone, friction, backlash, on-off etc.)	05 hrs
Chapter 02. Describing functions: Basic concept-first harmonic approximation, Describing functions of – ideal relay, relay with dead zone, saturation, dead-zone and saturation, dead-zone, dead zone with linear transfer characteristics, relay with hysteresis, relay with hysteresis and dead- zone.	05 hrs
Chapter 03. Introduction to Singular points and Phase plane methods Linearized system equations, Definition of phase plane, phase trajectory, system eigenvalues, singular points and its classification, examples on linearizing & singular points	05 hrs
Unit - II	
Chapter 04. Stability Analysis by describing function Limit cycles, Basic concepts of stability analysis (Nyquist criterion), Examples to determine amplitude and frequency of limit cycles, Merits & demerits of describing method analysis.	08 hrs
Chapter 05. Phase plane analysis of non-linear systems Phase trajectory construction by delta method and method of isoclines, computation of time, merits and demerits of phase plane method, Examples on delta and isoclines method. System analysis by phase-plane methods.	07 hrs
Unit - III	
Chapter 06. Stability analysis by direct methods Basic stability theorems, Positive definiteness of scalar and quadratic functions, Liapunov's second method, Liapunov's method for linear systems, Methods to construct Liapunov functions – Krasovic method and variable gradient method, Popov's stability criterion	10 hrs

Text Books:

1. Nagarath and Gopal, *Control system Engineering,* Wiley Eastern Ltd., 1995, 2nd edition.
Katsuhiko Ogata, *Modern Control Engineering,* PHI, 2002, 4th edition

Reference Book:

1. M. Gopal, *Control Systems-Principles and Design,* TMH 2002, 2nd edition

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Program: Electrical & Electronics Engineering		**Semester : VII**
Course Title: Modern Control Systems		**Course Code:25EEEE410**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hrs: 3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hrs: 40		**Exam Duration: 3 hrs**

Content	
Unit - I	
Chapter No. 01: State Space Analysis in continuous time Mathematical modelling of dynamic systems in state space, State space representation of Mechanical and electrical systems, State space representation of transfer functions, relations between state equation and transfer functions, Characteristics equation, eigen value and eigen vector of state matrix, Solution of time-invariant state equation, determination of State Transition Matrix, Controllability, Observability.	08 hrs
Chapter No. 02 : Controller Design Introduction to design of control systems in state space, design of phase lead and phase lag controllers in time and frequency domain, Pole placement design, State observers.	08 hrs
Unit - II	
Chapter No. 03: : State Space Analysis in Discrete time domain Z-Transform method for solving difference equations, Pulse Transfer Function, Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and it‟s Properties, Methods for Computation of State Transition Matrix, State Space Repreentation of discrete time systems, Matrix solving discrete time state space equations, Discretization of continuous time state – space equations	08 hrs
Chapter No. 04: Controllability, Observability & Stability Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability, Transfer matrix. Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation.	08 hrs
Unit - III	
Chapter No. 05: Non-Linear System Nonlinear Systems: Common Physical nonlinearities, The Phase-Plane Method, Basic concepts, singular Points, Stability of nonlinear systems, Construction of Phase trajectories, , The Describing function Method: Basic concepts, derivation of describing functions for common nonlinearities, Stability analysis by Describing Function approach, Lyapunov Stability Criterion	08 hrs
Text Books 1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition 2. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992	
Reference Books: 1. Digital Control and State Variable Methods by M.Gopal, TMH	

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Program: Electrical & Electronics Engineering		Semester : VII	
Course Title: Switched Mode Power Converters		Course Code: 25EEEE413	
L-T-P: 3-0-0	Credits: 03	Contact Hours: 3 hrs /Week	
ISA Marks: 50	ESA Marks: 50	Total Marks: 100	
Teaching Hours:40	Exam Duration: 03 Hrs		
Unit – I			
Chapter No. 1.DC Power Supplies: Introduction, transformer models, the flyback converter: Continuous Current Mode, Discontinuous Current Mode, Summary of flyback converter operation, the forward converter, summary of forward converter, operation, the doubly ended (two switch)forward converter, the push-pull converter, summary of push-pull converter operation, full-bridge and half-bridge DC-DC converters, multiple outputs, converter selection, power factor correction, simulation of DC power supplies, pwm control circuits, the Ac line filter, the complete DC power supply . (Need for power factor correction – Simulation demo…)			15 hrs
Unit – II			
Chapter No. 2. DC-AC Switched Mode Inverters: Introduction, basic concepts of switch-mode inverters, single phase inverters, three phase inverters, effect of blanking time on output voltage in inverters, other inverter switching schemes, rectifier mode of operation.			15 hrs
Unit – III			
Chapter No. 3. Multilevel Converters: Introduction, Generalized topology with a Common DC Bus, Converters Derived from the Generalized Topology, Diode Clamped Topology, Flying Capacitor Topology, Multi-pulse converter			05 hrs
Chapter No. 4. Diode Clamped Multilevel Converters: Introduction, Converter's structure and Functional description: voltage clamping, switching logic, Modulation of multilevel converters, Conventional SVPWM, Multilevel space vector modulation			05 hrs
Text Books:			
1. Ned Mohan, T. M. Undeland and W. Robbins, Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley and Sons, 2002			
2. Daniel W Hart, Power Electronics, 1, Tata McGraw-Hill, 2011			
3. YorkSergio Alberto González, Santiago Andrés Verne, María Inés Valla, Multilevel converters for Industrial Applications, CRC Press, 2014 .			
Reference Books:			
1. Rashid M. H, Power Electronics: Circuits, Devices and Applications, 3, PHI, 2005			
2. Bose B. K., , Power Electronics and AC Drives, 5, PHI, 2003			
3. Rashid M. H, Digital Power Electronics and Applications, 1, Elsevier, 2005			
4. V. Ramanarayanan, Switched Mode Power Converters Notes, IISC, Bangalore, 2008			

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Program: Electrical & Electronics Engineering		Semester: VII
Course Title: Digital Control System		Course Code: 25EEEE411
L-T-P: 3-0-0	Credit: 3	Contact Hrs: 3 Hrs/Week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40	Exam Duration:3 Hrs	

Unit – I	
Chapter No.1 Recapitulation of Discrete signals and Systems: Discrete-time and sampled data system; Time invariant system response, Recursive solution; Discrete convolution; Digital simulation of an analog system.	03 Hrs
Chapter No.2 Sampling and Reconstruction of signals: Impulse sampling; Frequency domain consideration; zero-order and first-order holds; Shanon's sampling theorem.	04 Hrs
Chapter No.3 Z-transform and its application: Z-transform analysis of sampled data system; Obtaining z-transform by convolution integral; Inverse z transform; Mapping between s-plane and z-plane; Linear difference equations, pulse response, Z-Transform method for solving difference equations; Pulse transforms function; Modified z-transform; Bilinear transformation; Frequency pre-warping.	08 Hrs
Unit - II	
Chapter No.4 Sampled Data Control Systems: Transfer Function of discrete data systems, Pulse and Z transform Functions, Transfer Function of discrete data systems with Cascade elements, Transfer Function of Zero- Order and 1st – Order Holds, Transfer Function of Closed Loop discrete data systems.	05 Hrs
Chapter No.5 Design of Discrete-time controller: Time-domain specifications; Error constants for different discrete control configurations; Digital PID controller; Relationship with analog and digital controller parameters: Frequency responses; Realization of position and velocity form of discrete-time PID controller	05 Hrs
Chapter No.6 State Space Analysis: State variables, State model for linear continuous-time system. Types of state models, Eigen value and Eigen vectors, Solution of state equation, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, State Space Representation of discrete time systems, Matrix solving discrete time state space equations, Discretization of continuous time state – space equations.	05 Hrs
Unit - III	
Chapter No.7 Controllability, Observability & Stability: Concepts of Controllability and Observability, Tests for controllability and Observability Duality between Controllability and Observability, Transfer matrix. Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation.	06 Hrs
Chapter No.8 State Feedback Controller: Design of state feedback controller through pole placement – Necessary and sufficient conditions.	04 Hrs

Text Books 1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition 2. B. C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992
Reference Books: 1. Digital Control and State Variable Methods by M.Gopal, TMH

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Program: Electrical & Electronics Engineering		**Semester: VII**
Course Title: Electricity & Safety Measures		**Course Code: 25EEEE412**
L-T-P: 3-0-0	**Credits:3**	**Contact Hours:3 hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Examination Duration:3hrs		

Introduction

This course on 'Electricity and Safety Measures' will introduce you to electricity, from generation to transmission to cities/ towns, to distribution up to the end user. You will learn the elementary electrical, overview of electrical power system, Quality of electrical supply, general tools and tackle, Major substation equipment, Operation & maintenance practices for substation and transformer in the first part of this course. While the use of electricity is a boon to us, its misuse could lead to major accidents. We shall learn importance of earthing and guidelines for providing earthing arrangements, Protection of the electrical equipment for safe use of electricity, Important electricity rules related to safety in the second part of this course. While we do take all precautions to avoid the unforeseen, what if some accident does happen? You will be introduced to the basic safety measures. You shall learn about the essential First-Aid measures. Immediate First-Aid may save life. It is essential to restore the electrical system, at the earliest after any disaster; this is the issue of Disaster Management. All these aspects are covered under the third part of this course. As a common interest course, this course helps in building up your knowledge and skill on electrical power and safety.

Course layout

Week 1: Elementary Electrical - Basics of Electricity
Week 2: Exposure to General Tools and Tackles,
Testing of wiring Installation
Week 3: Electrical Power System: Overview
Quality of Electrical supply
Power Distribution System - Basics
Distribution Line equipment
Week 4: Transformers Major Substation Equipment Operation & Maintenance Practices
Week 5: Earthing
Week 6: Electrical System Protection
Week 7: Important Electricity Rules Related to Safety
Week 9: Electrical Safety & Week 10: Accident Prevention & Protection
Week 11: First Aid
Week 12: Disaster Management

Books and references

- IGNOU course material available at eGyankosh
- Course OEE-001: Electricity & Safety Measures;
- Course OEE-002; OEEL-001 of Programme "Certificate of Competency in Power Distribution" being offered by SOET, IGNOU Block 2: Electrical Safety and Disaster Management of Course BEE-002:Energy Management,
- Block 2: Operation & Maintenance of course BEE-001: Power Distribution Sector of Programme "Advanced Certificate in Power Distribution" being offered by School of Engineering & Technology(SOET), IGNOU

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(Embedded System)

Program: Electrical & Electronics Engineering		**Semester: VI**
Course Title: Object Oriented Programming using C++		**Course Code: 24EEEE305**
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/Week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hours: 40	**Exam Duration: 02 Hrs**	

Unit - I	
Chapter No. 1: Fundamental concepts of object-oriented programming: Introduction to object-oriented programming, Programming Basics, Arrays and Strings, Functions/ methods (parameter passing techniques).	06 Hrs
Chapter No. 2: Classes and Objects: Introduction to classes & objects, Scope resolution operator, Data Members, Defining Member Functions, Encapsulation (Data hiding), visibility modifiers, Constructors &Destructors, Nested classes, Static data members, Inline function, Friend class and functions, passing objects as arguments, UML diagrams to describe classes and relationships.	12 Hrs
Chapter No. 3: Inheritance: Introduction to inheritance, Types of Inheritance, defining derived classes, Access Specifiers, Base and Derived class Constructors, initialization list in the constructor, member classes, Nesting of member classes, Virtual base classes, Making a private member inheritable.	10 Hrs
Unit – II	
Chapter No. 4: Polymorphism Virtual functions, Pure Virtual functions, Abstract classes, Reference variable, static functions, The 'this' pointer, Operator overloading	09 Hrs
Chapter No. 5: Exception Handling: Introduction to exceptions, Throwing an Exception, Try Block, Exception Handler (Catching an Exception), Multiple exceptions. Exceptions with arguments. Built-in exception class hierarchy.	10 Hrs
Chapter No.6: Templates and I/o streams : Class templates and Function templates, C++ Class Hierarchy, File Stream, Text File Handling, Binary File Handling, Error handling during file operations.	09 Hrs

Text Books :

1. Robert Lafore, Object oriented programming in C++, 4th Edition, Pearson education, 2009
2. Cay Horstmann, Big C++, 2nd Edition, John Wiley and sons, 2009

Reference Books:

1. The Complete Reference C++, Herbert Schildt, 4th Edition, TMH, 2005. Farrell, "An object-oriented approach to logic and design", 4th Edition, Cingage Publishers, 2012.
2. Lippman S B, Lajorie J, Moo B E, C++ Primer, 4ed, Addison Wesley, 2005.

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Program: Electrical & Electronics Engineering		Semester: VII
Course Title: AUTOSAR		Course Code: 25EEEE404
L-T-P: 2-0-1	Credits: 3	Contact Hours: 4 Hrs/Week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hrs: 24	Practical Hrs:16	Exam Duration: 2 hrs

UNIT-I	
Chapter No: 1. AUTOSAR Fundamentals Introduction to AUTOSAR – evolution, consortium, partnership; AUTOSAR layered Architecture and methodology; ASWC – AUTOSAR Basic software, Virtual Function Bus (VFB), Application Software Component, Types of SW-components; Run Time Environment (RTE) – RTE Generation Process: Contract Phase, Generation Phase.	05 hrs
Chapter No: 2. Overview of BSW BSW Constituents, Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces, Complex device drivers and BSW module configuration.	05 hrs
UNIT-II	
Chapter No: 3. Communication Stack Communication module, CAN stack, LIN stack and FlexRay stack, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM).	05 hrs
Chapter No: 4. MCAL and ECU abstraction Layer Microcontroller Drivers, Memory drivers: on-chip and off chip drivers, IO drivers (ADC, PWM, DIO), Communication drivers.	05 hrs
UNIT-III	
Chapter No: 5. Service Layer Diagnostic Event Manager, Function inhibits Manager, Diagnostic communication manager, Network management, Protocol data unit router, Diagnostic log and trace unit.	04 hrs
Lab Experiments: • Implementation of ASWC with OS and RTE • Integration of ASWC with communication stack • Code navigation in RTE • RTE Events trigger generation for runnables • Building wrappers for code migration • Implementation of CAN Communication Stack • Configure the COM Module for communication between ECUs • Monitoring the code flow from COM module to CAN using dbc file • Trace the Signal/ Protocol Data Unit in the com stack • Generate the Code for COM Send and COM Receive signal • Implementation of Gateway Functionality – Signal Routing , Application Routing and PDU Routing	16 hrs

Text Books:

1. Oliver Scheid, AUTOSAR Compendium-part 1- Application and RTE, 2015.
2. Ribbens, Understanding of Automotive electronics, 6th Edition, Elsevier, 2003
3. Denton.T, Advanced automotive fault diagnosis, 2000
4. David Smith, Kenneth Simpson, The Safety Critical Systems Handbook, 5th Edition, 2020

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VLSI Systems

Program: Electrical & Electronics Engineering		**Semester: VI**
Course Title: Architectural Design of Integrated Circuits		**Course code: 24EEEE303**
L-T- P: 1-0-2	**Credits: 03**	**Contact Hrs: 05 hrs/week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hrs: 14 hrs	**Lab Hrs: 48 hrs**	

Chapter No. 1. Digital Integrated Circuits Challenges in digital design, Design metrics, Cost of Integrated circuits, ASIC, Evolution of SoC ASIC Flow Vs SoC Flow, SoC Design Challenges. Introduction to CMOS Technology, PMOS & NMOS Operation, CMOS Operation principles, Characteristic curves of CMOS, CMOS Inverter and characteristic curves, Delays in inverters, Buffer Design, Power dissipation in CMOS, CMOS Logic, Stick diagrams and Layout diagrams. Setup time, Hold Time, Timing Concepts.	03 hrs
Chapter No. 2. System Building Blocks Modeling finite state Machines, Data Path and controller design, Synthesizable Verilog, Pipeline modeling	04 hrs
Chapter No. 3. Design and simulation of Micro - Architectural blocks Efficient technique/s for Algorithm to Architecture Mapping, Recent Trends on Adder/Subtractor Design, Efficient VLSI Architectures for Various DSP blocks (FIR filter, CORDIC, FFT), Pipeline Implementation of Processor, Verilog Modeling of Processor	04 hrs
Chapter No. 4. Timing Analysis Fundamentals of Efficient Design and Implementation strategies of Digital VLSI Design (Clock Tree synthesis, Timing Closure, Synthesis), Static Timing Analysis, Clock Skew	03 hrs

Reference Books:

1. Digital Design by Morris Mano M, 4th Edition.
2. Verilog HDL: A Guide to Digital Design and Synthesis by Samir Palnitkar, 2nd Edition.
3. Principles of VLSI RTL Design: A Practical Guide by Sapan Garg, 2011.
4. Tools: Questa Sim, Modelsim for Verilog, Cadance Geneus, Xilinx 14.2 ISE

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Program: Electrical and Electronics Engineering		Semester: VII Semester
Course Title: Design for Testability		**Course Code: 25EEEE414**
L-T-P: 1-0-2	**Credits: 3**	**Contact Hours: 5 Hrs/week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hours: 16 Hrs	**Examination Duration:2 Hrs**	

Chapter No. 1. Introduction to Design for Testability
Overview of the importance of design for testability in modern electronic systems.
Historical context and evolution of testability strategies.
Introduction to key concepts: fault models, testing methodologies, and industry standards (3 Hrs)

Chapter No. 2. Built-in Self-Test (BIST) Techniques
Principles and implementation of built-in self-test techniques.
Advantages and limitations of BIST in electronic circuit testing.
Lab sessions: Simulations and exercises focusing on BIST. (3 Hrs)

Chapter No. 3. Scan Chains and Serial Testing
Concept of scan chains and their role in serial testing.
Implementation and optimization of scan chains for improved testability.
Lab sessions: Hands-on exercises with scan chain design and testing (2 Hrs)

Chapter No. 4. Fault Modeling and Simulation
Development of fault models for electronic circuits.
Utilization of simulation tools to predict and analyze potential faults in a design.
and deskew. (2 Hrs)

Chapter No. 5. Design for Testability Strategies
Exploration of various design for testability strategies.
Case studies: Analyzing successful implementations of design for testability.(1.5 Hrs)

Chapter No. 6. Industry Standards in Testability
Overview of industry standards related to testability.
Compliance and certification requirements for testable designs. (1.5 Hrs)

Reference Books:
1. Tripathi, Suman. Advanced VLSI Design and Testability Issues. CRC Press, 2020.
2. Wang, Laung-Terng. VLSI Test Principles and Architectures. Morgan Kaufmann, 2006.
3. Huhn, Sebastian. Design for Testability, Electrical & Electronics Engineering and Reliability. Springer Nature, 2021.

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Program: Electrical and Electronics Engineering		Semester: VII Semester
Course Title: System on Chip Design		Course Code: 25EEEE415
L-T-P: 3-0-0	Credits: 3	Contact Hours: 3Hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 40Hrs	Examination Duration:3 Hrs	

Unit I

Chapter No. 1: Introduction

Introduction: Driving Forces for SoC - Components of SoC - Design flow of SoC Hardware/Software nature of SoC - Design Trade-offs - SoC Applications

Chapter No. 2: System Level Design

System-level Design: Processor selection-Concepts in Processor Architecture: Instruction set architecture (ISA), elements in Instruction Handing-Robust processors: Vector processor, VLIW, Superscalar, CISC, RISC—Processor evolution: Soft and Firm processors, Custom Designed processors- on-chip memory.

Unit II

Chapter No. 3: On-chip bus and IP based design

Interconnection: On-chip Buses: basic architecture, topologies, arbitration and protocols, Bus standards: AMBA, Core Connect, Wishbone, Avalon - Network-on chip: Architecture topologies-switching strategies - routing algorithms flow control, Quality-of-Service- Reconfigurability in communication architectures. IP based system design: Introduction to IP Based design, Types of IP, IP across design hierarchy, IP life cycle, Creating and using IP - Technical concerns on IP reuse – IP integration - IP evaluation on FPGA prototypes.

Chapter No. 4: SoC Implementation

SOC implementation: Study of processor IP, Memory IP, wrapper Design - Real-time operating system (RTOS), Peripheral interface and components, High-density FPGAs - EDA tools used for SOC design.

Unit III

Chapter 5: SoC Testing

SOC testing: Manufacturing test of SoC: Core layer, system layer, application layer-P1500 Wrapper Standardization-SoC Test Automation (STAT).

Text Books:

1. Michael J.Flynn, Wayne Luk, “Computer system Design: Systemon-Chip”, Wiley-India, 2012.
2. Sudeep Pasricha, Nikil Dutt, “On Chip Communication Architectures: System on Chip Interconnect”, Morgan Kaufmann Publishers, 2008.
3. W.H.Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Elsevier, 2008.

Reference Books:

1. Patrick Schaumont “A Practical Introduction to Hardware/Software Co-design”, 2nd Edition, Springer, 2012.
2. Lin, Y-L.S. (ed.), “Essential issues in SOC design: designing complex systems-on-chip. Springer, 2006.
3. Wayne Wolf, “Modern VLSI Design: IP Based Design”, Prentice-Hall India, Fourth edition, 2009.

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Program: Electrical & Electronics Engineering		Semester : VII
Course Title: Advanced IC Packaging		Course Code: 25EEEE405
L-T-P: 1-0-2	Credits: 03	Contact Hours: 5 hrs /Week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hours:16+48		Exam Duration: 03 Hrs

Chapter 1: Introduction to Advanced Semiconductor Packaging

- Overview of semiconductor packaging
- Evolution of packaging technologies
- Challenges and trends in advanced packaging

Chapter 2: Packaging Materials and Processes

- Materials used in advanced packaging
- Assembly and packaging processes
- Flip-chip, wafer-level packaging, and 3D packaging
- Thermal and reliability considerations

Chapter 3: System-in-Package (SiP) and Multi-Chip Modules (MCM)

- Introduction to SiP and MCM
- Design considerations for SiP and MCM
- Introduction to SerDes, on-die PHYs and signal integrity

Chapter 4: Advanced Interconnect Technologies

- Microbump and fine-pitch technologies
- Through-Silicon Via (TSV) and 3D interconnects
- High-density interconnects (HDI)

Chapter 5: Layout of Package Substrates (Lecture & Lab)

- Review provided bump-to-ball connectivity data and fill out assigned lab worksheet
- Open single-die package layout database in a commercial package design tool such as APD+ and explore signal routing and power planes, filling out assigned lab worksheet
- Given a bump-to-ball map and substrate layer information, implement substrate layout

Chapter 6: Layout of Silicon Interposers (Lecture & Lab)

- Layout a silicon interposer given a microbump map for an ASIC and C4 ball assignments using a commercial router such as Innovus

Reference Books

1. Rao R Tummala, Fundamentals of Device and Systems Packaging, McGraw Hill, 2020.
2. Glenn R. Blackwell, The Electronics Packaging Handbook, CRC Press, 2017.
3. Bernard S Matisoff, Handbook of Electronics Packaging Design and Engineering, Springer, 2012.
4. Rao R Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, 2001.

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Program: Electrical & Electronics Engineering		**Semester: VII**
Course Title: System Verilog using Verification		**Course code: 25EEEE406**
L-T- P: 1-0-2	**Credits: 03**	**Contact Hrs: 05 Hrs /week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hrs: 15Hrs	**Lab Hrs : 38 Hrs**	

Chapter No. 1. Verification Concepts Concepts of verification, importance of verification, Stimulus vs Verification, functional verification, test bench generation, functional verification approaches, typical verification flow, stimulus generation, direct testing, Coverage: Code and Functional coverage, coverage plan.	02 hrs
Chapter No. 2. System Verilog – Language Constructs System Verilog constructs - Data types: two-state data, strings, arrays: queues, dynamic and associative arrays, Structs, enumerated types. Program blocks, module, interfaces, clocking blocks, mod-ports.	02 hrs
Chapter No. 3. System Verilog – Classes & Randomization SV Classes: Language evolution, Classes and objects, Class Variables and Methods, Class instantiation, Inheritance, and encapsulation, Polymorphism. Randomization: Directed Vs Random Testing. Randomization: Constraint Driven Randomization.	02 hrs
Chapter No. 4. System Verilog – Assertions & Coverage Assertions: Introduction to Assertion based verification, Immediate and concurrent assertions. Coverage driven verification : Motivation, Types of coverage, Cover Group, Cover Point, Cross Coverage, Concepts of Binning and event sampling.	04 hrs
Chapter No. 5. Building Testbench Layered testbench architecture. Introduction to Universal Verification Methodology, OverVIIew of UVM Base Classes and simulation phases in UVM and UVM macros. Unified messaging in UVM, UVM enVIIronment structure, Connecting DUT- VIIrtual Interface	05hrs

Reference Books:

1. System Verilog LRM
2. Chris Spear, Gregory J. Tumbush – System Verilog for verification - a guide to learning the test bench language features - Springer, 2012

Tools: Questa Sim, NC Verilog, NC Sim, CVER + GTKWave, VCSMX, Modelsim for Verilog

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Program: Electrical & Electronics Engineering		**Semester: VII**
Course Title: CMOS ASIC Design		**Course code: 25EEEE407**
L-T- P: 1-0-2	**Credits: 03**	**Contact Hrs: 05 hrs/week**
ISA Marks: 67	**ESA Marks: 33**	**Total Marks: 100**
Teaching Hrs: 16 hrs	**Lab Hrs: 48 hrs**	

Chapter No. 1. Design of combinational and sequential logic gates in CMOS. Layout and characterization of standard cells. Verilog for representing gate level netlists. Sequential circuit timing and static timing analysis.	04 Hrs
Chapter No. 2. **Cell and net delays and cross-talk.** Rationale and implementation of scan chains for testing standard-cell based logic circuits.	04 Hrs
Chapter No. 3. Physical design of standard-cell based CMOS ASICs: scan insertion, placement, clock tree synthesis and routing.	04 Hrs
Chapter No. 4. Netlist transformations at each step of the physical design process. Net parasitic and parasitic extraction. Use of PLLs for clock generation and deskew.	05 Hrs
Chapter No. 5. Standard data formats for representing technology and design: LEF, Liberary, SDC, DEF and SPEF. Clock gating and power gating for reduction of device power consumption.	05 Hrs
Chapter No. 6. Design for reliability: electromigration, wire self heat and ESD checks and fixes. An overview of package design and implementation and system level timing	05 Hrs
Case Study : Design of counter	03 Hrs
Reference Books: 1. The Design & Analysis of VLSI Circuits, L. A. Glassey & D. W. Dobbepahl, Addison Wesley Pub Co.1985. 2. H. Bhatnagar, Advanced ASIC Chip Synthesis Using Synopsys Design Compiler Physical Compiler an PrimeTime, 2nd edition, 2001. 3. Springer Science+Business Media, LLC 2009 4. Tools: Cadence Innovous, Encounter	

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Course Content

Course Code: 25EEEE408	Course Title: Human Machine Interface	
L-T-P : 1-0-2	Credits: 3	Contact Hrs: 5/week
ISA Marks: 67	ESA Marks: 33	Total Marks: 100
Teaching Hrs: 14		Exam Duration (Theory + Practical): 1 Hr +2 Hrs

Content	
Chapter 1: Introduction to HMI - Overview of HMI, general introduction to HMI, HMI Architecture & Concepts/ HMI Sub-Components (Widgets, Framework, state machine)	02 Hrs
Chapter 2: Automotive HMI - Evolution of HMI in cars, HMI for car multimedia, GUI Tools (GTK, QT, HTML5)	03 Hrs
Chapter 3: UX and Guidelines - Introduction to UX design (theory, design thinking), graphics design (Blender, GIMP), 2D/3D rendering, OpenGL, GPU architectures, shader programming	02 Hrs
Chapter 4: Car Multimedia - Instrument cluster, in-vehicle infotainment, professional system/ rear-seat entertainment	02 Hrs
Chapter 5: App Development and Testing - App development for Android/ iOS, Unity, HMI testing and automation	03 Hrs
Chapter 6: Advanced Topics - Voice/ Gesture control, haptics, eye gaze sensor, Virtual/ Augmented Reality, Analytics	02 Hrs

Experiment Wise Plan

List of experiments/jobs planned to meet the requirements of the course.

Category: Lab Assignments		Total Weightage: 24		No. of lab sessions: 10.00
Expt./ Job No.	**Experiment / Job Details**	**Correlation of Experiment with the theory**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Widget design using GUI tools	1.00	6	Chapters 1 & 2
2	UX design using OpenGL, rendering using Blender	1.00	6	Chapters 1 & 3
3	Design instrument cluster for dashboard and infotainment control	1.00	6	Chapters 2, 3 & 4
4	Design an app to control vehicle infotainment system using a mobile device	1.00	6	Chapters 2, 3, 4 & 5

Category: Course Project		Total Weightage: 5		No. of lab sessions: 12.00
Expt./ Job No.	**Experiment / Job Details**	**Correlation of Experiment with the theory**	**Marks / Experiment**	**Correlation of Experiment with the theory**
1	Course Project	1.00	9	Chapters 1, 2, 3, 4 & 5
	Learning Outcomes: The students should be able to: 1. Apply the fundamental concepts of HMI design to generate requirements 2. Develop suitable UX design for HMI applications 3. Implement HMI solutions for given use case 4. Design test cases for HMI applications 5. Document the HMI application design development process			

Materials and Resources Required:

i. Donald Norman, “The Design of Everyday Things”, Basic Books (Revised Edition), 2014.
ii. Bill Hollifield, Dana Oliver, Ian Nimmo, and Eddie Habibi, “The High Performance HMI Handbook”, Plant Automation Services.
iii. Shuo Gao, Shuo Yan, Hang Zhao, and Arokia Nathan, “Touch-Based Human-Machine Interaction: Principles and Applications”, Springer Nature, 2021.
iv. https://aliresources.hexagon.com/brochures/maximize-operator-effectiveness-part-i-high-performance-hmi-principles-and-best-practices
v. https://aliresources.hexagon.com/all-resources/maximize-operator-effectiveness-part-ii-high-performance-hmi-principles-and-best-practices
vi. GTK - https://docs.gtk.org/
vii. Qt - https://doc.qt.io/
viii. Blender - https://www.blender.org/support/
ix. OpenGL - https://www.opengl.org/
x. TouchGFX - https://support.touchgfx.com/docs/introduction/welcome

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