KLE Technological University | Creating Value, Leveraging Knowledge

Curriculum Structure and Curriculum Content for the Academic year 2020-24
School : Electrical & Electronics Engineering
Program: UG

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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 endeavours.

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 nationality 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
1. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
2. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
3. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
4. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
5. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

6. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
7. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
8. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
9. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
10. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
11. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
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

	Semester								
Courses Semester wise	I	II	III	IV	V	VI	VII	VIII	
	Single variable calculus 18EMAB101 (4-1-0)	Multivariable Calculus 18EMAB102 (4-1-0)	Integral Transforms and Statistics 15EMAB203 (4-0-0)	Linear Algebra and Partial differential equations/ 15EMAB208 (4-0-0)/ Vector calculus and differential equations 15EMAB242 (4-0-0)	Electric Drives & Control 21EEEC301 (3-0-0)	Power System Modeling, Operation & Control 21EEEC302 (3-0-0)	Switched Mode Power Converters 17EEEC401 (3-0-0)	Embedded Linux 19EEEE402 (0-0-3)	Industry Internship Training 18EEEI493 (0-0-6) Industry Internship Project 20EEEW494(0-0-11)
	Engineering Chemistry 15ECHB102 (3-0-0)	Engineering Physics 15EPHB101 (3-0-0)	Circuit Analysis 19EEEC201 (4-0-0)	ARM Processor & Applications 15EEEC207 (3-0-0)	Power System Analysis & Stability 17EEEC302 (3-0-0)	Automotive Electronics 17EEEC307 (3-0-0)	Program Elective 3 AUTOSAR 21EEEE402 (3-0-0)	Artificial Intelligence 17EEEO402 (3-0-0)	
	C Prog for problem solving 18ECSP101 (0-0-3)	Engg Mechanics 15ECVF101 (4-0-0)	Analog Electronics Circuits 15EEEC202 (4-0-0)	Linear Control Systems 17EEEC204 (3-0-0)	OS & Embedded Systems 17EEEC303 (3-0-0)	Object Oriented Programming using C++ 19EEEC303 (2-0-1)	Program Elective 4 Traction system for Electric Vehicles 20EEEE401 (3-0-0) Powertrain Control Laboratory 20EEEE402 (0-0-3)	Capstone Project 21EEEW402 (0-0-11)	
	Engg Exploration 15ECRP101 (0-0-3)	Basic Electrical Engg 18EEEF101 (3-0-0)	Electrical Power Generation, Transmission & Distribution 19EEEC202 (3-0-0)	Electrical Machines 19EEEC204 (4-0-0)	Digital Signal Processing 20EEEC301 (3-0-0)	Program Elective 1 CMOS VLSI Circuits 19EEEE301 (3-0-0)	Program Elective 5 Smart Grid Technologies 17EEEE405 (3-0-0) Flexible AC Transmission Systems 19EEEE401 (3-0-0)		
	Basic Electronics 18EECF101 (4-0-0)	Design Thinking for Social innovation 20EHSP101 (0-1-1)	Digital Circuits 19EEEC203 (4-0-0)	Signals & Systems 19EEEC205 (3-0-0)	Linear Integrated Circuits 18EEEC301 (3-0-0)	Program Elective 2 Battery Management Systems 19EEEE302 (3-0-0) Modelling and Analysis of Hybrid Electrical Energy Systems18EEEE302 (3-0-0)	Constitution of India, Professional Ethics and Environmental Studies 15EHSA401 (0-0-0)		

	Basic Mechanical Engg 15EMEF101 (2-1-0)	Engg physics lab 16EPHP101 (0-0-1)	Microcontroller Architecture & Programming 15EEEP201 (0-0-2) / C Programming 18EEEF201 (0-0-2)	Power Electronics 20EEEC201 (3-0-0)	Machine Learning 19EEEC301 (2-0-1)	Professional Aptitude and Logical Reasoning 16EHSC301 (3-0-0)	Power System Simulation Lab 19EEEP401 (0-0-1)		
	Professional communication 15EHSH101 (1-1-0)	Problem Solving with Data Structures (18ECSP102) (0-0-3)	Analog Electronics Laboratory 15EEEP202 (0-0-1)	ARM Microcontroller Lab 15EEEP205 (0-0-1)	RTOS Lab 17EEEP306 (0-0-1)	Power Electronics & Drives lab 20EEEP301 (0-0-1)	Relay and High Voltage Engineering lab 20EEEP401 (0-0-2)		
			Digital Circuits Laboratory 15EEEP203 (0-0-1)	Digital System Design using Verilog 18EEEP203 (0-0-2)	Machines Lab 19EEEP301 (0-0-1)	Automotive Electronics Lab 17EEEP305 (0-0-1)	Senior Design Project 21EEEW401 (0-0-6)		
					Linear Integrated Circuits and Control System Lab 21EEEP301 (0-0-1)	Minor Project 17EEEW302 (0-0-6)	Research experience for Undergraduates(REU) 17EEEE490 (0-0-6)		
					Mini project 17EEEW301 (0-0-3)	Industry Readiness and Leadership skills 22EHSH302 (0.5-0-0)	Institutional Research Project 21EEEE491 (0-0-6)		
					Arithmetical thinking and analytical Reasoning 22EHSH301 (0.5-0-0)		Sponsored Research Project(SRP) 22EEEE493 (0-0-6)		
							Science & technology Advanced research Lab Project (23EEEE495) (0-0-6)		
Credits	23	21	23	23	24.5	26.5	21	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	15EPHB101	Engineering Physics	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	3	80	20	100	3 hours
7	16EPHP101	Engineering Physics Lab	BS	0-0-1	1	2	80	20	100	3 hours
			TOTAL	14-2-5	21	27				

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Semester - II

No	Code	Course	Category	L-T-P	Credits	Contact Hou	ISA	ESA	Total	Exam Duration (in Hours)
1	18EMAB102	Multivariable Calculus	BS	4-1-0	5	6	50	50	100	3 hours
2	15ECHB102	Engineering Chemistry	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	15ECRP101	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	15EMEF101	Basic Mechanical Engg.	ES	2-1-0	3	4	50	50	100	3 hours
7	15EHSH101	Professional Communication	HSS	1-1-0	2	3	50	50	100	3 hours
			TOTAL	**15-2-6**	**23**	**32**				

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Semester- III

No	Code	Course	Category	L-T-P	Credits	Contact Hou	ISA	ESA	Total	Exam Duration (in Hours)
1	15EMAB203	Integral Transforms and Statistics	ES	4-0-0	4	4	50	50	100	3 hours
2	19EEEC201	Circuit Analysis	PC	4-0-0	4	4	50	50	100	3 hours
3	15EEEC202	Analog Electronics Circuits	PC	4-0-0	4	4	50	50	100	3 hours
4	19EEEC202	Electrical Power Generation, Transmission & Distribution	PC	3-0-0	3	3	50	50	100	3 hours
5	19EEEC203	Digital Circuits	PC	4-0-0	4	4	50	50	100	3 hours
6	15EEEP201 / 18EEEC201	Microcontroller Architecture & Programming / C Programming	PC	0-0-2	2	4	80	20	100	2 hours
7	15EEEP202	Analog Electronics Laboratory	PC	0-0-1	1	2	80	20	100	2 hours
8	15EEEP203	Digital Circuits Laboratory	PC	0-0-1	1	2	80	20	100	2 hours
			TOTAL	**19-0-4**	**23**	**27**				

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Semester- IV

No	Code	Course	Category	L-T-P	Credits	Contact Hour	ISA	ESA	Total	Exam Duration (in Hours)
1	15EMAB208/15EMAB242	Linear Algebra and Partial differential equations /Vector calculus and differential equations (Lateral Entry	ES	4-0-0	4	4	50	50	100	3 hours
2	15EEEC207	ARM Processor & Applications	PC	3-0-0	3	3	50	50	100	3 hours
3	17EEEC204	Linear Control Systems	PC	3-0-0	3	3	50	50	100	3 hours
4	19EEEC204	Electrical Machines	PC	4-0-0	4	4	80	20	100	3 hours
5	19EEEC205	Signals & Systems	PC	3-0-0	3	3	50	50	100	3 hours
6	20EEEC201	Power Electronics	PC	3-0-0	3	3	50	50	100	3 hours
7	15EEEP205	ARM Microcontroller Lab	PC	0-0-1	1	2	80	20	100	3 hours
8	18EEEP203	Digital System Design using Verilog	PC	0-0-2	2	4	80	20	100	3 hours
			TOTAL	**20-0-3**	**23**	**26**				

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Semester- V

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	21EEEC301	Electric Drives & Control	PC	3-0-0	3	3	50	50	100	3 hours
2	17EEEC302	Power System Analysis & Stability	PC	3-0-0	3	3	50	50	100	3 hours
3	17EEEC303	OS & Embedded Systems	PC	3-0-0	3	3	50	50	100	3 hours
4	20EEEC301	Digital Signal Processing	PC	3-0-0	3	3	50	50	100	3 hours
5	18EEEC301	Linear Integrated Circuits	PC	3-0-0	3	3	50	50	100	3 hours
6	19EEEC301	Machine Learning	PC	2-0-1	3	3	50	50	100	3 hours
7	17EEEP306	RTOS Lab	PC	0-0-1	1	2	80	20	100	2 hours
8	19EEEP301	Machines Lab	PC	0-0-1	1	2	80	20	100	2 hours
9	21EEEP301	Linear Integrated Circuits and Control System Lab	PC	0-0-1	1	2	80	20	100	2 hours
10	22EHSH301	Arithmetical Thinking & Analytical Reasoning	ES	0.5-0-0	0.5	2	100	--	100	3 hours
11	17EEEW301	Mini project	PW	0-0-3	3	6	80	20	100	3 hours
			TOTAL	**17.5-0-7**	**24.5**	**30**				

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Semester- VI

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	21EEEC302	Power System Modeling, Operation & Control	PC	3-0-0	3	3	50	50	100	3 hours
2	17EEEC307	Automotive Electronics	PC	3-0-0	3	3	50	50	100	3 hours
3	19EEEC303	Object Oriented Programming using C++	PC	2-0-1	3	3	50	50	100	3 hours
4	19EEEE301	**Program Elective 1** CMOS VLSI Circuits	PE	3-0-0	3	4	50	50	100	3 hours
5	19EEEE302 18EEEE302	**Program Elective 2** Battery Management Systems Modelling and Analysis of Hybrid Electrical Energy Systems	PE	3-0-0	3	3	50	50	100	3 hours
6	16EHSC301	PA&LR	HSC	3-0-0	3	3	50	50	100	3 hours
7	20EEEP301	Power Electronics & Drives lab	PC	0-0-1	1	2	80	20	100	2 hours
8	17EEEP305	Automotive Electronics Lab	PC	0-0-1	1	2	80	20	100	2 hours
9	22EHSH302	Industry Readiness & Leadership Skills	ES	0.5-0-0	0.5	1	100	--	100	3 hours
10	17EEEW302	Minor Project	PW	0-0-6	6	12	80	20	100	3 hours
			TOTAL	**17.5-0-9**	**26.5**	**36**				

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Semester- VII

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in Hours)
1	17EEEC401	Switched Mode Power Converters	PC	3-0-0	3	3	50	50	100	3 hours
2	21EEEE402	Program Elective 3 AUTOSAR	PE	3-0-0	3	3	50	50	100	3 hours
3	20EEEE401 20EEEE402	**Program Elective 4** Traction system for Electric Vehicles Powertrain Control Laboratory	PE	3-0-0	3	3	50	50	100	3 hours
4	17EEEE405 19EEEE401	**Program Elective 5** Smart Grid Technologies Flexible AC Transmission Systems	PE	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	0	3 hours
6	19EEEP401	Power System Simulation Lab	PC	0-0-1	1	2	80	20	100	2 hours
7	20EEEP401	Relay and High Voltage Engineering lab	PC	0-0-2	2	4	80	20	100	2 hours
8	21EEEW401	Senior Design Project	PW	0-0-6	6	12	50	50	100	2 hours
			TOTAL	**15-0-9**	**21**	**30**				

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Semester- VIII

No.	Code	Course	Category	L-T-P	Credits	Contact Hou	ISA	ESA	Total	Exam Duration (in Hours)
1		**Program Elective 6**	PE	3-0-0	3	3	50	50	100	3 hours
2		Open Elective	OE	3-0-0	3	3	50	50	100	3 hours
3	21EEEW402	Capstone Project	PW	0-0-1	11	22	50	50	100	3 hours
				TOTAL	**17**	**28**				

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Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	23	21	23	23	24.5	26.5	21	17	179

List of Open Electives

Sr. No	Name of the Course	Course Code
1	Artificial Intelligence	17EEEO402

List of Program Electives

Sr. No	Name of the Course	Course Code
1	Battery Management Systems	19EEEE302
2	Traction Systems for Electric Vehicles	20EEEE401
3	Powertrain Control Laboratory	20EEEE402
4	Modelling & Analysis of Hybrid Electrical Energy Systems	17EEEE403
5	Smart Grid Technologies	17EEEE405
6	Flexible AC Transmission System (FACTS)	19EEEE401
7	CMOS VLSI Circuits	19EEEE301
8	AUTOSAR	21EEEE402
9	Embedded Linux	19EEEE402

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I Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: UG		**Semester: I**	
Course Title: Single Variable Calculus		**Course Code: 18EMAB101**	
L-T-P: 4-1-0	**Credits: 05**	**Course Code: 18EMAB101**	
CIE Marks: 50	**SEE Marks: 50**	**Contact Hours: 4 Hrs/Week**	
Teaching Hours: 50	**Examination Duration: 3Hrs**	**Total Marks: 100**	
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 **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			07 Hrs 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 **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			06 Hrs 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, Hughes-Hallett Gleason, Wiley India Ed, 4ed, 2009.
2. Thomas Calculus, George B Thomas, Pearson India, 12ed, 2010

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Program : UG		**Semester: I**
Course Title: Engineering Physics		**Course Code: 15EPHB101**
L-T-P: 3-0-0	**Credits:3**	**Contact Hrs: 3 Hrs/week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hrs : 40Hrs	**Exam Duration: 3 Hrs**	

Unit I	
Chapter No.1: Conduction in semiconductors Atomic theory: The atom, electron orbits and energy levels, energy bands, Conduction in solids: Electron motion and hole transfer, conventional current and electron flow Conductors, semiconductors and insulators: Bonding force between atoms, Energy bands in different materials. n-type and p-type Semiconductors: Doping, n-Type material, p-Type material, Majority and minority charge carriers, Effects of heat and light, charge carrier density. Semiconductor conductivity: Drift current, diffusion current, charge carrier velocity, conductivity, Hall Effect. (Text 1 Page No 1-33)	05 Hrs
Chapter No.2: Junctions 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. p-n Junction Diode characteristics and parameters: Forward and reverse characteristics, diode parameters. Diode approximations: Ideal diode and practical diodes, piecewise linear characteristics, DC equivalent circuits. **DC load line analysis:** DC load line, Q-Point, calculating load resistance and supply voltage. **Temperature Effects:** Diode power dissipation, forward voltage drop, dynamic resistance. **Diode AC models:** Junction capacitance, AC-equivalent circuits (Reverse biased and forward biased), reverse recovery time. **Diode specifications:** Diode data sheets, low power diodes, rectifier diodes **Diode testing:** Ohmmeter tests, use of digital meter, plotting diode characteristics. **Zener diodes:** Junction break down, circuit symbols and packages, characteristics and parameters, data sheet, equivalent circuits. (Text 1 Page No 34-71)	10 Hrs
Unit II	
Chapter No.3: Electrostatics Review on vectors: Coordinate Systems, Vector and Scalar Quantities, Properties of Vectors, Components of a Vector and Unit Vectors (Text 2 Page No 59-77) **Electric Fields:**	15 Hrs

Properties of Electric Charges, Charging Objects by Induction, Coulomb's Law, Analysis Model: Particle in a Field (Electric), 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, Conductors in Electrostatic Equilibrium **Electric Potential:** Electric Potential and Potential Difference, Potential Difference in a Uniform Electric Field, Electric Potential and Potential Energy Due to Point Charges, Obtaining the Value of the Electric Field from the Electric Potential, Electric Potential Due to Continuous Charge Distributions Electric Potential Due to a Charged Conductor, Applications of Electrostatics **Capacitance and Dielectrics:** Definition of Capacitance, Calculating Capacitance, Combinations of Capacitors, Energy Stored in a Charged Capacitor, Capacitors with Dielectrics, Electric Dipole in an Electric Field, An Atomic Description of Dielectrics (Text 2 Page No 690-807)	
Unit – III	
Chapter 4: Electromagnetics **Magnetic Fields:** Analysis Model: Particle in a Field (Magnetic), 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 Law, The Magnetic Force Between Two Parallel Conductors, Ampere's Law, The Magnetic Field of a Solenoid, Gauss's Law in Magnetism, Magnetism in Matter **Faraday's Law:** Faraday's Law of Induction, Motional emf, Lenz's Law, Induced emf and Electric Fields Generators and Motors, Eddy Currents (Text 2 Page No 868-969)	10 Hrs

Text Books:

1. David A Bell, "Electronics Devices and Circuits", Fifth Edition, Oxford University Press.
2. Serway and Jewett, "Physics for Scientists and Engineers-with Modern Physics", 9th Edition, CENGAGE learning. 2014

Reference Books:

1. Jacob Millman and Christos Halkias, "Electronic Devices and Circuits" TMH
2. R P Feynman, Robert B Leighton , Matthew Sands, The Feynman Lectures on Physics Vol-II, Norosa Publishing House (1998).
3. Ben G Streetman, Solid State Electronic Devices, Prentice Hall, 1995

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Program: UG		**Semester: I**
Course Code: 15ECVF101		**Course Title: Engineering Mechanics**
L-T-P: 4-0-0	**Credits:4**	**Contact Hrs: 4 Hrs/Week**
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**
Teaching Hrs: 50	**Exam Duration: 3 Hrs**	

Unit I	
Chapter No. 1: Overview of Civil Engineering Evolution of Civil Engineering Specialization, scope and role. 1 Hr Impact of Civil Engineering on National economy, environment and social & cultural fabric. 2 Hrs Challenges and Opportunities for Civil Engineers Civil Engineering Marvels, Future challenges, Higher education and Research. 1 hr	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 3 Hrs 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. 4 Hrs Equilibrium of coplanar concurrent force system: Conditions of equilibrium, Action & Reaction, Free body diagram, Lamis' theorem. Numerical problems on equilibrium of forces. 5 Hrs	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. 5 Hrs	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. 5 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. 8 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. 6 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. 5 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. 5 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, 3Ed., New Age International Pub. Pvt. Ltd., New Delhi, 2008.
3. Kumar, K.L., Engineering Mechanics, 3ed., Tata McGraw Hill Publishing Company, New Delhi, 2003.
4. Punmia, B.C., Jain, A. and 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.
5. Irving H Shames, *Engineering Mechanics*, 3rd edition, Prentice-Hall of India Pvt. Ltd, New Delhi-110 001, 1995.

Back

Program: UG		**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**		
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.			

Back

Program: UG		**Semester: I**
Course Title: Basic Electrical Engineering		**Course Code:18EEEF101**
L-T-P: 3-0-0	**Credits: 3**	**Contact: 3 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching : 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, Kirchhoff'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:	05 Hrs

Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing. Numerical.	

Text Books:

1. Hughes, 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, McGraw 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

Back

II Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: UG			**Semester: II**
Course Title: Design Thinking for Social Innovation			**Course Code: 20EHSP101**
L-T-P : 0-1-1		**Credits: 2**	**Contact Hrs.: 2 Hrs/week**
ESA Marks: 80		**ISA Marks: 20**	**Total Marks: 100**
Teaching Hours : 16 Hrs.		**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 Behavioural 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)	**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)

		5. Making it 6. Embracing Ambiguity (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	**<u>Reading assignments</u>** • Hand-out on Community Study and Issue Identification • Case Study on "E-GramSeva" • Case Study on "Janani Agri Serve" **<u>Class Presentations</u>** • Initial observations being made by the group **(Literature Survey of Places of Hubli-Dharward) 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	**<u>Reading assignments</u>** • Hand-out on Overview of Inspiration **<u>Class Presentations</u>** • Entirety of the Social Issue • Identification of the Stake Holders **(Examples on Fluorescent Curtain and Students' Punctuality for Class)** • Interview Questions **(Role Play on Interview with Stakeholders)**	• Familiarization of the respective templates with the help of sample case study

	• 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** • Hand-out 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** • Hand-out 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	**Reading assignments** • Hand-out 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

		4. Donation 5. Envelop Funding 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** • Hand-out 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

Back

Program: UG		Semester: II
Course Title: Engineering Physics lab		Course Code: 16EPHP101
L-T-P: 0-0-1	Credits : 1	Contact Hrs.: 02 Hrs/Week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching Hrs.: 16	Examination Duration: 3 Hrs.	
Experiments		
Expt. No. 1 Four probe method		
Expt. No. 2 V-I characteristics of p-n junction diode		
Expt. No. 3 Zener diode characteristics		
Expt. No. 4 Hysteresis loss		
Expt. No. 5 Transistor characteristics		
Expt. No. 6 Measurement of dielectric constant		
Expt. No. 7 Resonance frequency of LCR circuits		
Expt. No. 8 Study of frequency response of passive components		
Expt. No. 9 Calibration of thermocouple		
Expt. No. 10 Calibration of electrical meters		

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Program: UG		**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	**Examination Duration: 3Hrs.**	

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, Hughes-Hallett Gleason, Wiley India Ed, 4ed, 2009.
2. Thomas Calculus, George B Thomas, Pearson India, 12ed, 2010

Back

Program: UG		**Semester: II**
Course Title: Engineering Chemistry		**Course Code: 15ECHB102**
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	**Examination Duration: 3Hrs.**	

Unit – I	
Chapter No.1 Chemical Bonding Introduction, Ionic bond, factors influencing the formation of Ionic bond: Ionization energy. Electron affinity & electro negativity and properties of Ionic compounds. Covalent bond: Valence Bond theory & Molecular Orbital theory – formation of hydrogen molecule, factors influencing the formation of covalent bond, polar and non-polar covalent bond, dipole moment, problems on calculation of percentage of Ionic character and properties of covalent compounds, Co-ordinate bond: formation of hydronium ion and ammonium ion.	04 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, E_{cell} & E^0_{cell}. Batteries: Classification, Characteristics, Lead - acid, Lithium ion battery. Fuel cells - Methonol-O_2 fuel	06 Hrs
Chapter No.3 Polymers Introduction, polymerization; mechanism of polymerization taking ethylene as an example. Determination of molecular weight of a polymer – numerical problems. Commercial polymers - Plexi glass, PS, polyurethane. Polymer composites: Carbon fiber and Epoxy resin – synthesis, properties and applications. Introduction to conducting polymers, mechanism of conduction in poly acetylene and application	06 Hrs
Unit – II	
Chapter No.4 Plating Techniques Introduction, technological importance. Electroplating, Principles of electroplating. Factors affecting nature of electrodeposit, throwing power, Numerical problems on throwing power, Electroplating process of gold by acid cyanide bath. Electro less plating, advantages of electro less plating over electroplating. Electro less plating of Cu and its application in the manufacture of PCB.	04 Hrs
Chapter No.5 Wafer Technology Introduction, physical and chemical properties of silicon. Purification of silicon; chemical vapor deposition (CVD) process, zone refining process. Crystal growth; preparation of single crystal silicon by Zochralski crystal pulling technique – numerical problems. Crystal slicing and wafer preparation. Fabrication process: thermal oxidation, diffusion, ion implantation – numerical problems, epitaxial growth, masking and photolithography, wet etching, dry etching.	09 Hrs

Chapter No.6 Material Chemistry Liquid Crystals – Types of liquid crystals, applications of Liquid Crystal in Display system. Fluorescence and Phosphorescence – Jablonski diagram, Thermoelectric and Piezoelectric materials – meaning, properties and applications	03 Hrs
Unit – III	
Chapter No.7 Instrumental methods of measurement Advantages over conventional methods. Electro analytical methods: Potentiometer - principle, methodology and applications. Opto-analytical methods: Colorimeter - Principle, methodology and applications. Spectral methods of analysis: UV – Spectrophotometer - Instrumentation and applications.	04 Hrs
Chapter No.8 Environmental Chemistry: Water: Sources and ill effects of water pollutants – fluoride and nitrate; determination of total hardness of water by EDTA method – numerical problems. Sewage: Determination of Biological Oxygen Demand by Winkler's method – numerical problems and determination of Chemical Oxygen Demand – numerical problems.	04 Hrs

Text Books:

1. A text Book of Engineering Chemistry, 1st edition, Dara. S. S, S. Chand & 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

Reference Books:

1. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand, 1999, New Delhi.
2. Hand book of batteries, David Linden, Thomas B Reddy, 3rd edition Mc Graw Hill publications, 2001, New York.
3. Polymer Science, 6th Edition, Gowariker V.R., Viswanathan N.V., Sreedhar J., New Age International (P) Ltd, 2007, New Delhi.
4. Solid State Devices& Technology, 4thEdition, V.Suresh Babu, sanguine Technical Publishers, 2005, Bangalore.
5. Material Science & Engineering: An Introduction, 9th Edition, Calister William D, John Wiley and sons, 2007, New York.
6. Instrumental methods of Chemical nalysis, 5th Edition, Gurudeep R Chatwal, Shan K Anand, Himalaya Publishing House Pvt. Ltd, 2010, Mumbai.
7. VLSI Technology, 2nd Edition, S.M.Sze, McGraw Hill Series in electrical and computer engineering, 1998, New York.

Back

Program: UG		**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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Electrical Science Stream Syllabi Content

Program: UG		**Semester: II**
Course Title: Engineering Exploration		**Course Code: 15ECRP101**
L-T-P: 0-0-3	**Credits: 3**	**Contact Hrs.: 78**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hrs.: 78	**ESA Exam Duration: 3 Hrs.**	

No	Content	Sessions
1	Introduction to Engineering and Engineering Study	1
2	Role of Analysis in Engineering, Analysis Methodology	2
3	Data Analysis Graphing	2
4	Basics of Engineering Design, Multidisciplinary Nature of Engineering Design	5
5	Project Management	1
6	Sustainability in Engineering	2
7	Ethics	1
8	Modeling, Simulation and Data Acquisition using Software Tool	1
9	Platform based development : Arduino	3
9	Course Project	3

Reference Books:

1. Engineering Fundamentals & Problem Solving by Arvid Eide, Roland Jenison, Larry Northup, Steven, Mc GrawHill Higher Education, 6th Edition (2011)
2. Engineering Exploration (Edited Book, 2008) by Pearson Publication

Back

Program: UG		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: 50Hrs.	**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, DeMorgan'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 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 Scientist 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. RamakantGaikawad , Operational Amplifiers & applications, PHI, 2000

Back

Program: UG		**Semester: II**	
Course Title: Basic Mechanical Engineering		**Course code: 15EMEF101**	
L-T-P: 2-1-0	**Credits: 3**	**Contact Hrs. 4 Hrs/Week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hrs: 50		**Exam Duration: 3 Hrs.**	
Unit I			
Chapter No.1 Introduction to Mechanical Engineering: Definition of engineering, Mechanical Engineering, Branches of Mechanical Engineering, Who are Mechanical Engineers?, Mechanical Engineers' top ten achievements. Visit to Workshop and Machine Shop, Tools, Safety Precautions Video presentations			02 Hrs
Chapter No.2 Manufacturing Engineering: Basics of Manufacturing What is manufacturing?, The main manufacturing sectors, The importance of the main manufacturing sectors to the Indian economy, Scales of production Classification of manufacturing Processes. Advances in Manufacturing: CNC machines, Mechatronics and applications			08 Hrs
Chapter No.3 Demonstration on working of Lathe, milling, drilling, grinding machines Demonstration on Welding (Electric Arc Welding, Gas Welding, Soldering) Demonstration and Exercises on Sheet metal work. Visit to Learning Factory			05 Hrs
UNIT II			
Chapter No.4 Design Engineering: Power Transmission Elements Overview Design Application: • Belt Drives. Types, 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. Speed, Torque, and Power in Gear pair. Simple and Compound Gear trains. Numerical Problems. Ball and Roller Bearings, Types, Applications Design Problems like a moving experience, aluminium can crusher Video presentations			06 Hrs 05 Hrs
Chapter No.5 Thermal Engineering 1: Prime Movers. Internal Combustion Engines: Classification, IC engine parts, 2 stroke SI and CI engine, 4 Stroke SI and CI Engine, PV diagrams of Otto and Diesel cycles, Comparison of 2 stroke and 4 stroke engine, comparison of CI and SI engine, Problems on Engine Performance, Future trends in IC engines			04 Hrs
Chapter No.6 Case study on power requirement of a bike, car or any machine Video presentations			01 Hrs
UNIT III			
Chapter No.7 Thermal Engineering 2: Thermal Systems' Applications Refrigeration system, Air conditioning system, Pumps, Blowers and Compressors, Turbines, and their working principle and specifications Case study on selection of various thermal systems			05 Hrs

Video presentations	
Text Books: • Jonathan Wickert and Kemper Lewis, An Introduction to Mechanical Engineering, Third Edition, 2013- Cengage Learning.4 • K.R.Gopalkrishna, Sudhir Gopalkrishna, S.C. Sharma. A Text Book of Elements of Mechanical Engineering, 30th Edition, Oct 2010,–Subhash Publishers, Bangalore.	
Reference Books: • Course Material developed by the Department of Mechanical Engineering. • S.K.H. Chowdhary, AKH Chowdhary, Nirjhar Roy, The Elements of Workshop Technology - Vol I & II , 11th edition 2001, Media Promoters and Publishers. • Basic Manufacturing, Roger Timings, Third edition, Newness, An imprint of Elsevier	

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Program: UG		**Semester: II**
Course Title: Professional Communication		**Course Code: 15EHSH101**
L-T-P-: 1-1-0	**Credits: 2**	**Contact Hrs.: 2Hrs/week**
ESA Marks: 50	**ISA Marks: 50**	**Total Marks: 100**
Teaching Hrs.: 40	**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.	08 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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Curriculum Content- Course wise

III Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: UG		**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-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. 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.

Back

Program: UG		**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.			08 Hrs
Chapter No.2 Network Theorems: Homogeneity, Superposition and Linearity, Thevenin's & Norton's Theorems, Maximum Power Transfer Theorem, Millman's theorem, Reciprocity principle, Application of theorems to both ac and dc networks			08 Hrs
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
Unit-II			
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			08 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			12 Hrs
Unit-III			
Chapter No.6 Sinusoidal Steady state analysis: Characteristics of sinusoids, Forced response to sinusoidal functions, The complex forcing function, Phasor & 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

Back

Program: UG		**Semester: III**	
Course Title: Analog Electronics Circuits		**Course Code:15EEEC202**	
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 Applications of a Junction diode: Recap of diode models: Exponential model, piece-wise linear model, constant voltage drop model, ideal diode model, small signal model. Applications of diodes as a Clipping circuit and clamping circuits; Voltage doubler.			06 Hrs
Chapter No.2 Bipolar junction transistors. : The common emitter characteristics, Dependence of IC on the collector voltage-the early effect large signal operation-the transfer characteristics, the amplifier gain, operation as a switch. DC load line and bias point, base-bias, collector to base bias, voltage divider, comparison of bias circuit, small signal models of bipolar transistors, two port modelling of amplifiers, ac analysis of BJT circuits-coupling and bypass capacitor, Common emitter circuit analysis, CE circuit with un-bypassed emitter resistor.			07 Hrs
Unit-II			
Chapter No.3 MOSFETs structure and physical operation: Device structure, operation with no gate voltage, creating a channel for current flow, applying small vds, operation as vds is increased, derivation of the id-vds relationship, the P-channel MOSFET, complementary MOS or CMOS, operating the MOS transistor in the sub threshold region. Current-voltage characteristics: circuit symbol, the id vs vds characteristics, finite output resistance in saturation, characteristics of the p-channel MOSFET, the role of the substrate-the body effect, temperature effects, breakdown and input protection. MOSFET circuits at DC			07 Hrs
Chapter No.4 Biasing of MOSFETs: MOSFET circuits at DC continued. Biasing in MOS amplifier circuits, By fixing VGS; By fixing VG; With drain to gate feedback resistor; Constant current source biasing and Numerical			08 Hrs
Chapter No.5 MOSFET amplifiers: Small signal operation and models, single stage MOS amplifiers, the MOSFET internal capacitance and high frequency model, frequency response of CS amplifier. (CD and CG), Cascode Connection: Implications on gain and Bandwidth			12 Hrs
Unit-III			

Chapter No.6 Feedback Amplifiers: General feedback structure (Block schematic), Feedback desensitivity factor, positive and negative feedback Nyquist stability Criterion, RC phase shift oscillator, Wein bridge Oscillator, merits of negative feedback, feedback topologies: series-shunt feedback amplifier, series-series feedback amplifier, and shunt-shunt and shunt-series feedback amplifier with examples (T1:7.1 to 7.6)	05 Hrs
Chapter No.7 Large Signal Amplifiers: Classification of amplifiers: (A, B, AB and C); Transformer coupled amplifier, push-pull amplifier Transistor case and heat sink. (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	
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	

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Program: UG		**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 equipment. **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:	05 Hrs

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.	
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. S.K. 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: UG	**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: UG		Semester: III
Course Title: Microcontroller Architecture & Programming		Course Code: 15EEEP201
L-T-P: 0-0-2	Credits: 2	Contact Hours: 4 Hrs /week
ISA Marks: 80	ESA Marks:20	Total Marks: 100
Teaching + Lab. Hours: 48	Examination Duration:2 Hrs	

Unit-I

Expt. No.1 **Overview of Architecture of 8051:** • Processor Core and Functional Block Diagram • Description of memory organization • Overview of ALL SFR's and their basic functionality	02+02 Hrs
Expt. No.2 **Low Level programming Concepts:** • Addressing Modes • Instruction Set and Assembly Language programming(ALP) • Developing, Building, and Debugging ALP's	02+02 Hrs
Expt. No.3 **Middle Level Programming Concepts:** • Cross Compiler • Embedded C language implementation, programming, & debugging • Differences from ANSI-C • Memory Models • Library reference • Use of directives • Functions, Parameter passing and return types	04+04 Hrs
Expt. No.4 **On-Chip Peripherals Study, Programming, and Application:** • Ports: Input/Output • Timers & Counters • UART • Interrupts	04+04 Hrs
Expt. No.5 **External Interfaces Study, Programming and Applications :** • LEDS • Switches(Momentary type, Toggle type) • Seven Segment Display: (Normal mode, BCD mode, Internal Multiplexing & External Multiplexing) • LCD (8bit, 4bit, Busy flag, custom character generation) • Keypad Matrix	04+04 Hrs
Expt. No.6 **Selective Discussion during Project Development** • A/D & D/A Converter • Stepper Motor, DC Motor • ZIGBEE	08+08 Hrs

• GSM/GPS • USB • MMC & SD • Ethernet MAC	

Text Books :

1. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005
2. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C "- PHI, 2006 / Pearson, 2006

Reference Books:

1. Predko ; "Programming and Customizing the 8051 Microcontroller" –, TMH
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005
3. Ajay V.Deshmukh; "Microcontrollers- Theory and Applications",TMH,2005
4. Dr.RamaniKalpathi and Ganesh Raja; "Microcontroller and its applications", Sanguine Technical publishers,Bangalore-2005

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Program: UG		**Semester: III**
Course Title: Analog Electronics Lab		**Course Code: 15EEEP202**
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: 3 Hrs**	
List of Experiments:		
Demonstration		
Expt. No. 1 Study of multimeters, power supplies, function generators, Oscilloscopes; Identification of various components and devices, e.g. resistors, capacitors, diodes ,transistors etc		
Exercise		
Expt. No. 2 Design & analyze Diode Clipping (single/double ended) circuits.		
Expt. No. 3 Design & analyze Positive and Negative Clamping circuits		
Expt. No. 4 Study the input and output characteristics of BJT		
Expt. No. 5 Study the input and output characteristics of MOSFET		
Expt. No. 6 To study the basic current mirror circuit		
Expt. No. 7 Study of transformer-less Class B push pull power amplifier and determination of its conversion efficiency		
Structured Enquiry		
Expt. No.8 To determine the frequency response of RC Coupled single stage BJT amplifier(CE mode) &also the gain, input & output impedances		
Reference Books: 1. **"**Electronic Devices & circuit Theory " by Nashelsky & Boylstead,PHI,9th Ed 2. "Integrated Electronics" By 'Jacob Millman and Christos Halkias',McGraw Hill, 3. **"**Electronic Principles" by A.P. Malvino, TaTa MGH,5th Ed		

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Program: UG		**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: 3 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: UG		**Semester: III**
Course Title: C Programming		**Course Code: 18EECF204**
L-T-P : 0-0-2	**Credits : 2**	**Contact Hours : 04 Hrs /week**
ISA Marks : 80	**ESA Marks : 20**	**Total Marks : 100**
Teaching Hours: 48	**Exam Duration:2 Hrs**	

Expt. No.1 Introduction to C Programming Introduction to algorithms / flowcharts and its notations.	02 Hrs
Expt. 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.	07 Hrs
Expt. No.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. No.4 Iterative statements while, do while, for, nested statements	03 Hrs
Expt. No.5 Functions Introduction, Function declaration, definition, call, returns statement, passing parameters to functions, introduction to macros.	10 Hrs
Expt. No.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. 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.	05 Hrs
Expt. No.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: UG		**Semester: IV**
Course Title: Linear Algebra and Partial differential equations		**Course Code: 15EMAB208**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 04 Hrs/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: UG		**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**	

Content	
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:

1. 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: UG		**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 2nd 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: UG		**Semester: IV**
Course Title: ARM Processor & Applications		**Course Code: 15EEEC207**
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	**Examination Duration:3 Hrs**	

Unit-I	
Chapter No.1 Interrupt programming 8051-Interrupts and programming(both assembly and 'C'): Interrupts for timer and serial communication	05 Hrs
Chapter No.2 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.3 Introduction to ARM instruction set Data processing instruction, Branch instruction, Load store instruction, Software interrupt instruction, Program status register instruction, Conditional execution, Example programs	05 Hrs
Unit-II	
Chapter No.4 Introduction to THUMB instruction set The Thumb programmer model, ARM-Thumb interworking, other branch instructions, Data processing instructions, Single/Multiple register load store instruction, Stack operation, Software interrupt instructions, example programs.	05 Hrs
Chapter No.5 Assembler rules and Directives Introduction, structure of assembly language modules, Predefined register names, frequently used directives, Macros, Miscellaneous assembler features. Example programs.	02 Hrs
Chapter No.6 Exception handling Introduction, Interrupts, error conditions, processor exception sequence, the vector table, Exception handlers, Exception priorities, Procedures for handling exceptions.	04 Hrs
Chapter No.7 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.	04 Hrs
Unit-III	
Chapter No.8 LPC2148 Architecture and applications On-chip memory, GPIOs, Timers, UART, ADC, I2C, SPI , RTC, ARM interfacing techniques and programming: LED, LCD, Stepper Motor, Buzzer, Keypad, ADC and I2C	10 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: UG		**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: UG		**Semester: IV**
Course Title: Power Electronics		**Course Code: 20EEEC201**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/Week**
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: 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: UG		**Semester: IV**
Course Title: ARM Microcontroller Lab		**Course Code: 15EEEP205**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 25	**Exam Duration: 2 Hrs**	
List of 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		
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 look up table.		
Expt. No. 3 Write an ALP to i. Find the length of the carriage r1eturn terminated string. ii. Compare two strings for equality. ii.		
Expt. No. 4 Write an ALP to pass parameters to a subroutine to find the factorial of a number or prime number generation.		
Expt. No. 5 Write a 'C' program to test working of LED's using LPC2148.		
Expt. No. 6 Write a 'C' program & demonstrate an interfacing of Alphanumeric LCD 2X16 panel to LPC2148 Microcontroller.		
Expt. No. 7 Write an ALP to generate the following waveforms of different frequencies i. Square wave ii. Triangular iii. Sine wave II. Write a 'C' program & demonstrate interfacing of buzzer to LPC2148(using external interrupt)		
Expt. No. 8 Write a program to set up communication between 2 microcontrollers using I2C.		
Expt. No. 9 Write a 'C' program & demonstrate an interfacing of ADC.		
Structured Enquiry		
Expt. No. 1 Write a program that displays a value of 'Y' at port 0 and 'N' at port 2 and also generates a square wave of 10Khz with Timer 0 in mode 2 at port pin p1.2 XTAL =22MHz		
Expt. No. 2 Write a C program that continuously gets a single bit of data from P1.7 and sends it to P1.0 in main, while simultaneously i. creating a square wave of 200us period on pin P2.5. ii. Sending letter 'A' to serial port. Use Timer 0to create square wave.		
Open Ended		
Expt. No. 1 Develop an ARM based application using i. sensors ii. Actuators iii. displays		

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Program: UG		**Semester : IV**
Course Title: Digital System Design using Verilog		**Course Code: 18EEEP203**
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4 Hrs/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 Verilog HDL 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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V Semester Bachelor of Engineering (Electrical & Electronics Engineering)

Program: UG		**Semester: V**	
Course Title: Electric Drives and Control		**Course Code: 21EEEC301**	
L-T-P: 3-0-0	**Credits: 04**	**Contact Hours: 3 Hrs/Week**	
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40	**Examination Duration: 3Hrs**		
Unit-I			
Chapter No. 1. An introduction to Electrical Drives & its Dynamics: Electrical drives. Advantages of electrical drives. Parts of electrical drives, Choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, speed torque conventions and multi quadrant operation. Nature and classification of load torques, calculation of time and energy loss in transient operations.			05 Hrs
Chapter No. 2. DC Motor Drives: Starting braking, single phase fully controlled rectifier control of dc separately excited motor, Single-phase half-controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor, three phase half-controlled rectifier control of dc separately excited motor, multi-quadrant operation of dc separately excited motor fed from fully controlled rectifier. Rectifier control of dc series motor, chopper-controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.			10 Hrs
Unit – II			
Chapter No. 3. Induction Motor Drives: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting, braking, Stator voltage control, variable frequency control from voltage sources, voltage source inverter control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery.			10 Hrs
Chapter No. 4. Synchronous Motor and Brushless DC Motor Drives: Operation from fixed frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self-controlled synchronous motor drive, PMAC motor drives, brushless dc motor drives			05 Hrs
Unit – III			
Chapter No. 5. Stepper Motor and Switched Reluctance Motor Drives: Stepper Motor: variable reluctance, permanent magnet, torque versus stepping rate characteristics drives circuits for stepper motors Switched Reluctance Motor: Operation and control requirements, converter circuits, modes of operation			05 Hrs
Chapter No. 6. Solar and Battery Powered Drives: Solar panels, motors suitable for pump drives, battery powered vehicles, solar powered electrical vehicles			05 Hrs
Text Books : 1. G. K Dubey, *"Fundamentals of Electrical Drives"*, 2nd ed., Narosa Publishing House, Chennai, 2002.			
Reference Books:			

1. N. K. De and P. K. Sen, Electrical Drives, PHI, 2007.
2. S. K. Pillai, A First Course On Electric Drives, Wiley Eastern Ltd, 1990.
3. V. R. Moorthi, Power Electronics, Devices, Circuits & Industrial Applications, Oxford University Press, 2005.

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Program: UG		**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 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			05 Hrs
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

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Program: UG		**Semester: V**
Course Title: OS and Embedded Systems		**Course Code: 17EEEC303**
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: Introduction and System structures Operating system definition; Operating System operations; Different types of operating system – Mainframe systems, Multi programmed systems, Time sharing systems, Desktop systems, Parallel systems, Distributed systems, Real time systems.	03 Hrs
Chapter No. 2: Process Management Process concept; Process scheduling; Operations on processes; Inter-process communication. Multi-Threaded Programming: Overview; Multi threading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling; Thread scheduling**.**	06 Hrs
Chapter No. 3: Memory Management Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames; Thrashing. **(Textbook: Galvin)**	06 Hrs
Unit-II	
Chapter No. 4: Introduction To Real-Time Operating Systems Introduction To Real-Time Operating Systems: Introduction to OS, Introduction to real time embedded system- real time systems, characteristics of real time systems, the future of embedded systems. Introduction to RTOS, key characteristics of RTOS, its kernel, components in RTOS kernel, objects, scheduler, services, context switch, Scheduling types: Preemptive priority-based scheduling, Round-robin and preemptive scheduling.	08 Hrs
Chapter No. 5: Tasks, Semaphores and Message Queues: Tasks, Semaphores and Message Queues: A task, its structure, A typical finite state machine, Steps showing the how FSM works. A semaphore, its structure, binary semaphore, mutual exclusion (mutex) semaphore, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared-resource-access synchronization. A message queue, its structure, Message copying and memory use for sending and receiving messages, Sending messages in FIFO or LIFO order, broadcasting messages. *(Textbook: Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1E, Published, 2011)*	07 Hrs
Unit-III	

Chapter No. 6: Typical Embedded System: Classification and purposes of embedded system, Characters and Quality attributes of embedded system, Core and Supporting components of embedded system, Embedded firmware **(Text book: Shibu KV)**	05 Hrs
Chapter No. 7: Wired and Wireless Protocols: Bus communication protocol (USB,I^2C,SPI), Wireless and mobile system protocol (Bluetooth, 802.11 and its variants, ZigBee), Embedded design cycle-case study-ACVM (Text book: Rajkamal)	05 Hrs
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: 1. Qing Li with Caroline Yao, Real-Time Concepts for Embedded Systems, 1st edition	

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Program: UG		**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
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
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		

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Program: UG		**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 Modelling, 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 Averagingamplifiers (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”, 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.

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Program: UG		Semester: V
Course Title: Machine Learning		Course Code: 19EEEC301
L-T-P: 2-0-1	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 Introduction Introduction to Machine Learning, Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised and Reinforcement learning, Dataset formats, Basic terminologies.	5 Hrs
Chapter No.2 Supervised Learning Linear Regression, Logistic Regression Linear Regression: Single and Multiple variables, Sum of squares error function, The Gradient descent algorithm, Application, Logistic Regression, The cost function, Classification using logistic regression, one-vs-all classification using logistic regression, Regularization.	10 Hrs
Unit-II	
Chapter No.3 Supervised Learning: Neural Network Introduction to perception learning, Implementing simple gates XOR, AND, OR using neural network. Model representation, Gradient checking, Back propagation algorithm, Multi-class classification, Application- classifying digits, SVM.	10 Hrs
Chapter No.4 Unsupervised Learning: Clustering Introduction, K means Clustering, Algorithm, Cost function, Application.	05 Hrs
Unit-III	
Chapter No.5 Unsupervised Learning: Dimensionality Reduction Dimensionality reduction, PCA- Principal Component Analysis. Applications, Clustering data and PCA.	04 Hrs
Chapter No.6 Introduction to Deep Learning What is deep learning?, Difference between machine learning and deep learning, Convolution Neural Networks (CNN), Recurrent Neural Networks(RNN), When to use deep learning?	08 Hrs
Text Books 1. Tom Mitchell, Machine Learning, 1, McGraw-Hill. , 1997 2. Christopher Bishop, Pattern Recognition and Machine Learning, 1, Springer, 2007	
Reference Books: 1. Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning : Data Mining, , Springer, 2009	

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Program: UG		**Semester: V**
Course Title: RTOS Lab		**Course Code: 17EEEP306**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 32**
CIE Marks: 20	**SEE Marks: 80**	**Total Marks: 100**
Teaching Hours: 32	**Examination Duration: 2 Hrs**	
List of Experiments		
Expt. No.1 Write a C program to use on chip Timers in LPC2148 and generate required delay		
Expt. No. 2 Write a C program to demonstrate the concept of basic RTOS programming by using RTX RTOS		
Expt. No. 3 Write a 'C' program & demonstrate concept of Round Robin Task Scheduling.		
Expt. No. 4 Write a C program to demonstrate the concept of basic preemptive scheduling algorithm by using RTX RTOS		
Expt. No. 5 Write a 'C' program & demonstrate concept of Events and Flags for inter task communication using RTX RTOS		
Expt. No. 6 Write a 'C' program & demonstrate concept of Mailbox.		
Expt. No. 7 Write a 'C' program & demonstrate concept of Semaphore.		
Expt. No. 8 Write a 'C' program & demonstrate concept of interrupts(hardware and software)		
Expt. No. 9 Write a C program to interface I2C-RTC with LPC2148		
Expt. No. 10 Write a C program to interface SPI-EEPROM with LPC2148		
Structured Enquiry		
Expt. No. 11 Real-Time OS Application which successfully demonstrates the use of various RTOS concepts		

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Program: UG		**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		
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: UG		Semester: V
Course Title: Linear Integrated Circuits and Control System Lab		Course Code: 21EEEP301
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: UG		**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	**Hrs**
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: UG		**Sem: VI**	
Course Title: Power System Modelling, Operation & Control		**Course Code: 21EEEC302**	
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/week**	
CIE Marks: 50	**SEE Marks: 50**	**Total Marks: 100**	
Teaching Hours: 40	**Exam Duration: 3 Hrs**		
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 Y_{bus} and Z_{bus}, Primitive element representations, primitive performance equations,. Formation of Y-bus by method of Inspection, Introduction to graph theory- definitions of terms, Bus incidence matrix, Y-bus by the method of singular transformation, Examples on Y-bus formation by singular transformation (with no mutual coupling) and Inspection method, Z-bus building algorithm-addition of uncoupled branches and links, modification of Z-bus for changes in elements not mutually coupled, Examples on Z-bus formation			08 Hrs
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.			07 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.			08 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.			07 Hrs
Unit-III			
Chapter No.5 Reactive power and voltage control : Power flow through a line, Relation between voltage, power and reactive power at a node, Brief descriptions of methods of voltage control-by injection of reactive power and tap changing transformer. Generator reactive power control by AVR-simplified AVR system model, AVR response.			05 Hrs
Chapter No.6 Power System Simulations: Simulation of automatic generation control, simulation of small signal stability of a SMIB power system, Transient stability simulation of SMIB power system using trapezoidal integration, simulation of classical economic load dispatch Algorithm			05 Hrs

Text Books

1. Stagg and El-Abid, Computer Methods in power system analysis, First Edition, Mc-Graw Hill, 1968
2. Kothari and Nagarath, Modern power system analysis, 3rd Edition, Tata McGraw Hill, 2004

Reference Books:

1. P. Kundur, Power system stability and control, First Edition, Tata McGraw Hill, 2007
2. Hadi Sadat, Power System analysis, Ed. First Edition, Tata McGraw Hill, 2002
3. A.R. Bergen and Vijay Vittal, Power system analysis, Ed. First Edition, Pearson Ed, 2009

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Program:UG		**Semester: VI**	
Course Title: Automotive Electronics		**CourseCode:17EEEC307**	
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 - 1			
Chapter No: 1. Introduction to Vehicle Drivelines / Powertrain Systems Overview of Automotive industry, ECU Design Cycle: Types of model development cycles (V and Agile), Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics and cluster. Introduction to power train, manual and automatic transmissions, automotive axles, 4-wheel and 2-wheel drives, Vehicle braking fundamentals, Steering Control, Overview of Hybrid Vehicles,			05 Hrs
Chapter No: 2. Automotive Control Systems Design Derivation of models and design of control strategies for powertrain control modules and integration into automotive platforms. Engine control functions, Fuel control, Electronic systems in Engines, Development of control algorithm for EMS with consideration of vehicle performance. Automotive grade microcontrollers: Architectural attributes relevant to automotive applications, Automotive grade processors ex: Renesas, Quorivva, and Infineon.			06 Hrs
Chapter No: 3. Automotive Sensors and Actuators Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Smart Nodes, Examples of sensors: Accelerometer (knock sensors), wheel speed sensors, Engine speed sensor, Vehicle speed sensor, Throttle position sensor, Temperature sensor, Mass air flow (MAF) rate sensor, Exhaust gas oxygen concentration sensor, Throttle plate angular position sensor, Crankshaft angular position/RPM sensor, Manifold Absolute Pressure (MAP) sensor. Actuators: Engine Control Actuators, Solenoid actuator, Exhaust Gas Recirculation Actuator.			04 Hrs
Unit - 2			
Automotive Stability and Safety Systems Passive/active safety systems and design philosophies. Investigation of stability issues associated with vehicle performance and the use of sensors and control system strategies for stability enhancement. Implementation and application to intelligent cruise control, lane departure warning systems, ABS, Traction Control, active steering systems, vehicle dynamic control systems.			08 Hrs
Chapter No:4. Automotive communication protocols Overview of Automotive communication protocols : CAN, CAN FD, SOME/ IP Protocol, LIN , Flex Ray, MOST			07 Hrs
Unit - 3			
Chapter No: 5. Overview of ADAS/AV and Functional safety standards Advanced Driver Assistance Systems (ADAS), Autonomous vehicle basics, sensing, planning and controls for autonomous driving, connected vehicles.			05 Hrs

Functional Safety: Need for safety standard-ISO 26262, safety concept, safety process for product life cycle, safety by design, validation.	
Chapter No:6. Diagnostics and Reliability Discussion of legislated state, federal and international requirements. On-board automotive sensors to monitor vehicle operation, typical diagnostic algorithms. Analytical methods for designing fault-tolerant systems and assessing vehicle reliability, including safety critical systems and 'limp-home' modes. Use of handheld scanners and specialized diagnostic equipment to classify faults. Diagnostic protocols: KWP2000 and UDS.	05 Hrs

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. Denton.T, Advanced automotive fault diagnosis, 2000
4. Konrad Reif Ed , Brakes, Brake Control and Driver Assistance Systems, Professional Automotive
   Information, Springer, 2014
5. Hans-Leo Ross, Functional Safety for Road Vehicles, Springer, 2016
6. 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:UG		**Semester: VI**
Course Title: Object Oriented Programming using C++		**Course Code:19EEEC303**
L-T-P: 2-0-1	**Credits: 3**	**Contact Hours: 4 Hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Exam Duration: 03 Hrs**	

Unit - I	
Chapter 01: Introduction Principles of Object Oriented Programming, Procedure oriented and Object oriented Programming, Basic Concepts of OOP, Benefits and Applications of OOP, Beginning with C++, Simple C++ program, C++ with classes, Structure of C++ program, Creating, compiling and linking C++ programs.	04 Hrs
Chapter 02: Classes and Objects Structures and Classes, Specifying a Class, Defining Member functions, C++ program with class, Access Specifiers, Scope Resolution Operators, Inline functions, Static Data Members, Static Member Functions, Friend Functions.	07 Hrs
Chapter 03: Constructors and Destructors Introduction, Parameterized Constructors, Multiple Constructors, Copy Constructor, Dynamic Constructor, Destructors, Dynamic allocation of objects - new and delete operators.	04 Hrs
Unit - II	
Chapter 04: Inheritance Introduction, Defining Derived Classes, Types of Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes.	06 Hrs
Chapter 05: Virtual Functions and Polymorphism Pointers to objects, this pointer, Pointers to Derived classes, Virtual Functions. Pure Virtual Functions.	05 Hrs
Chapter 06: Exception Handling Basics, Exception Handling Mechanism, Throwing, Catching and Rethrowing Exceptions.	04 Hrs
Unit - III	
Chapter 07: Function Overloading, Operator Overloading Function Overloading, Overloading Constructors, Defining operator Overloading, Unary and Binary operator overloading, Rules for overloading operators.	05 Hrs
Chapter 08: Templates, STL Class Templates, Function Templates, Overloading of Template functions, Components of STL, Containers, Iterators, Application of Container Classes.	05 Hrs

Text Books :

1. E.Balagurusamy, Object Oriented Programming with C++, 4th edition, Tata McGraw Hill, 2008
2. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGrawHill, 2003

Reference Books:

1. Yashavant P. Kanetkar, Let Us C++, 1st, BPB Publications,
2. Stanley B. Lippmann, Josee Lajore, Barbara E. Moo, C++ Primer, 4th Edition, Pearson Education, 2005

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Program: UG		Semester: VI
Course Title: Automotive Electronics lab		Course Code: 17EEEP305
L-T-P-0-0-1	Credits: 1	Contact Hours:2Hrs/week
ISA:80	ESA:20	Total Marks :100
Laboratory Hours :24	ExamDuration:2Hrs	

Demonstration Experiment

Expt No.1 Electronic engine control system: Injection and Ignition control system, Transmission trainer modules.

Exercise Experiments

Expt No.2 Simulation of an automobile engine

Expt No.3 Modeling a vehicle motion on a flat surface during hard acceleration, deceleration and steady acceleration.(ABS and suspension system)

Expt No.4 Basic gate logic simulation and modeling using Simulink and realization on the hardware platform.

Expt No.5 Modeling Seat belt warning system, and Vehicle speed control based on the gear input.

Expt No.6 EGAS modeling and simulation using Simulink and realization on the hardware platform.

Expt No.7 Interior lighting control modeling with state flow

Expt No.8 Gear input transmission over CAN bus using ARM Cortex m3 and signal analysis using CANalyzer/BusMaster software. Code driven and Model driven integration for Vehicle speed control function based on the gear input.

Structured Enquiry

1.Develop Matlab code for stepper motor control and convert it to Simulink model and port it on to an embedded hardware

2.Develop a C code for LCD display device and convert it to Simulink model and port it to embedded hardware/FPGA

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Program: UG		**Semester: VI**
Course Title: Power Electronics and Drives Lab		**Course Code: 20EEEP301**
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**	
Category: Demonstration		
Expt No.1 Introduction to Sciamble workbench software		
Expt No.2 Characterization of a DC motor		
Expt No.3 Characterization of a three phase induction motor		
Exercise Experiment / Job Details		
Expt No.1 Switched-mode DC-DC converter		
Expt No.2 DC motor speed control		
Expt No.3 Four quadrant operation of DC motor		
Expt No.4 Volts/Hertz control of three-phase induction motor.		
Structured Enquiry Experiment / Job Details		
1. To design and mathematically model the DC/IM drive. (PI Controller Design) 2. Experimentally verify the operability of the controller design using workbench		

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Program: UG		Semester: VI
Course Title: Industry Readiness & Leadership Skills		Course Code: 22EHSH302
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	Hours
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

Program: UG		Semester: VI
Course Title: PA&LR		Course Code: 16EHSC301
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 – 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: UG		**Semester: VII Sem**
Course Title: Switched Mode Power Converters		**Course Code: 17EEEC401**
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.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
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: UG		Semester: VII
Laboratory Title: Power System Simulation Lab		Course Code:19EEEP401
L-T-P: 0-0-1	Credits: 1	Contact Hours:2Hrs/week
ISA Marks:80	ESA Marks:20	Total Marks:80
Teaching Hours:28 Hrs	Examination Duration:3 Hrs	
Experiment / Job Details		
To use interactive simulation software "SofTCAPS" for the simulation of (i)Load flow analysis by Gauss-Seidel and NR models (ii) Voltage control analysis by shunt capacitor and tap changing transformer (iii) P-V Curve at a load bus		
To use interactive software "SofTCAPS" for the simulation of Economic load dispatch problem with and without coordinating the transmission losses		
Experiment / Job Details		
To form bus admittance matrix [Ybus] by singular transformation.		
To form [Ybus] by the method of inspection		
ABCD constants and line performance using short and medium π/T models		
Experiment / Job Details		
Each batch (consisting of 4 students) will work on one problem from the below mentioned sets, obtain the simulation results, carry out the analysis, interpret the results, draw practical conclusions from them and prepare a report. (a) To formulate and develop MATLAB/Scilab program/ SIMULINK model on one of the power problem which include, but not limited to -Load frequency control method, Study to determine the effect of excitation on dynamic stability, Comparison of various numerical techniques for stability study, Multimachine transient stability study, Load flow model development, (b) To employ an interactive power system software to simulate a given problem such as multimachine transient stability, multimachine small signal stability, contingency analysis, performance comparison of various load flow models, economic load dispatch etc.		
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Program: UG		Semester: VII
Laboratory Title: Relay and High Voltage Engineering lab		Course Code:20EEEP401
L-T-P: 0-0-2	Credits: 2	Contact Hours:4Hrs /week
ISA Marks:80	ESA Marks:20	Total Marks:100
Teaching Hours:32 Hrs	Examination 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

Program: UG		**Semester : VI**	
Course Title: Battery Management Systems		**Course Code: 19EEEE302**	
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: Introduction to electric vehicle & hybrid electric vehicle, types of batteries and their specific applications, Lithium-ion battery fundamentals: Battery Operation, Battery Construction, Battery Chemistry, Safety, Longevity, Performance, and Integration. (introduction to broad spectrum of batteries)			03 Hrs

Chapter No.2. Battery Models: Battery Models, Overview, self-Discharge Modelling and parameter identification using SOC/OCV , Thevenin Equivalent Circuit, Hysteresis, Coulombic Efficiency, Nonlinear Elements	04 Hrs
Chapter No.3. BMS (Black-box approach): Need for BMS, Typical inputs, typical outputs and typical functions Battery management system network in a typical electric vehicle	02 Hrs
Chapter No.4. BMS Architectures: Monolithic, Distributed, Semi-Distributed, Connection Methods, Additional Scalability, Battery Pack Architectures	02 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 **(5 Hrs)**	05 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	05 Hrs
Chapter No.9. SoC Estimation: Coulomb counting, SoC corrections, OCV measurements, temperature compensation	02 Hrs
Unit - III	
Chapter No.10. BMS communications: Overview, Network Technologies ,I2C/SPI, RS-232 and RS-485 134, Local Interconnect Network, CAN 136 ,Ethernet and TCP/IP ,Modbus ,FlexRay, Network Design	05 Hrs
Chapter No.11. Battery Safety: Functional Safety, Hazard Analysis, Safety Goals, Safety Concepts and Strategies, Reference Design for Safety.	05 Hrs
Text Books : 1. Phillip Weicker*"A Systems Approach to Lithium-Ion Battery Management"* 2013, Artech house publisher	
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: UG		**Semester : VII**
Course Title: Traction Systems for Electric Vehicles		**Course Code: 20EEEE401**
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. Motion and dynamic equations for vehicles Introduction to hybrid and electric vehicles, dynamics of hybrid and electric vehicles, motion and dynamic equations for hybrid and electric vehicles.		05 Hrs

Chapter No. 2. Vehicle Power Plant and Transmission Characteristics The drive train configuration, Various types of vehicle power plants, The need of gearbox in a vehicle, The mathematical model of vehicle performance	05 Hrs
Chapter No. 3: 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	05 Hrs
Unit - II	
Chapter No. 4. Permanent Magnet Machines for Hybrid and Electric Vehicles Permanent Magnet (PM) Machines, Principle of Operation of PM Machine, Operation of PM Machine Supplied by DC-AC Converter with 120oMode of Operation, Operation of PM Machine Supplied by DC-AC Converter with 180oMode of Operation	07 Hrs
Chapter No. 5. Permanent Magnet Machines suitability Electric Vehicles Relevance /operation of PM Motor specific to electric vehicles, Operation of PM Machine Supplied by DC-AC Converter with 120 degree Mode of Operation, Operation of PM Machine Supplied by DC-AC Converter with 180 degree Mode of Operation, Steady state characteristic operation of PM motor and importance of reluctance torque	08 Hrs
Unit - III	
Chapter No. 6. Control of PM machines Control Strategies of PM Machines, Constant Torque Angle Control, Constant Mutual Air gap Flux Linkage Control, Optimum Torque per Ampere Control	05 Hrs
Chapter No. 7. Drive cycle analysis and sizing of Electric Machine 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 Power, Constant Power Speed Ratio, EM Sizing, Sizing Power Electronics	05 Hrs
Text Books: 1. Chris Mi and M Abul Masrur, "*Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives*", John Wiley & Sons, 2018.	

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Program: UG		**Semester : VII**
Course Title: Powertrain Control Laboratory		**Course Code: 20EEEE402**
L-T-P: 0-0-3	**Credits: 3**	**Contact Hrs: 6 Hrs/week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hrs: Plan for 12 Weeks (12*6 = 72 Hours = 24 Lab sessions of 3 Hrs each)	**Exam Duration: 2 Hrs**	
Experiment List		
Expt. No. 1 Introduction to Matlab-Simulink (Numerical methods, configuration settings, data acquisition, data representation)		
Expt. No. 2 Battery Modelling and Simulation a. Series and Parallel connection		(4 Sessions)

b. Charge and discharge curves of individual cell and battery pack. c. SoC algorithms d. Passive and Active Cell Balancing	
Expt. No. 3 Mathematical Modelling and Simulation of Power Converters e. Bi-directional DC-DC converters (For interface between Inverter and battery) f. Three phase voltage source inverter (motor driver)	(3 Sessions)
Expt No. 4 dq Transformation theory g. Parks transformation h. Clarke's transformation	(1 sessions)
Expt No. 5 Characterization of a three phase Induction motor a. Determine the parameters of the Induction machine and verify voltage-speed characteristic of the motor	
Expt No. 6 Induction Motor Drive i. dq Model of Three Phase Induction Machine j. Scalar Control (Constant Voltz/Hertz Law) k. Vector Control strategies i. Direct Torque Control ii. Field Oriented Control	(4 sessions)
Expt No. 7 PMBLDC Drive l. Model of BLDC motor m. Closed loop Speed Control Strategies	(4 sessions)
Expt. No. 8 PMSM Drive n. dq Model of PMSM machine o. Scalar Control (Constant Voltz/Hertz Law) p. Vector Control strategies i. Direct Torque Control ii. Field Oriented Control	(4 sessions)
Course Project (4 lab Sessions)	
1. System Integration and testing (End-to-End Simulation)	
2. Experimental Verification (Build sub modules throughout the semester)	

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Program: UG		**Semester: VI**
Course Title: Modelling & Analysis of Hybrid Electrical Energy Systems		**Course Code: 17EEEE403**
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 Photovoltaic Energy Conversion Systems Photovoltaic Definitions, Introduction to PV Systems, System Pre-Sizing, Feasibility of Photovoltaic Systems, Maintenance of Photovoltaic Systems, Irradiance Modelling, PV Array modelling	08 Hrs

Chapter No. 2 Wind Energy Conversion Systems Introduction, Global Structure of a Conversion Wind System, Introduction to Wind Systems, Maintenance of Wind Systems, Total Costs for Wind Turbine Installation, Onshore and Offshore Wind Power Technologies	07 Hrs
Unit-II	
Chapter No. 3 Wind Energy Conversion & Power Electronics modelling Wind Energy Conversion modelling, Power Electronics modelling: Soft Starter, Capacitor Bank, Diode Rectifier, The Back-to-Back PWM-VSI, Tandem Converter, Matrix Converter, Multilevel Converter, DC/DC Converter, Load modelling, Grid Model, Empirical modelling of Power Converters	08 Hrs
Chapter No. 4 Optimization of PV & Wind System Conversion Introduction to optimization algorithms, Maximum power point tracking algorithms, Efficiency of a MPPT Algorithm, Comparison of Different Algorithms	07 Hrs
Unit-III	
Chapter No. 5 Hybrid Energy Systems : Basic knowledge on Hybridizing solar PV module with wind energy system and diesel system, modelling of hybrid solar PV and wind energy conversion system, Converters used for hybrid solar PV and wind energy conversion system.	05 Hrs
Chapter No. 6 Grid Integration Techniques in Renewable Energy Systems Grid Issues in integrating renewable energy systems. Converters used for grid integration techniques and its control strategy, Filters used for grid integration techniques and its control strategy.	05 Hrs
Text Books: 1. Djamila Rekioua Ernest Matagne, "Optimization of Photovoltaic Power Systems Modelling, Simulation and Control" , Green Energy and Technology, Springer 2. Djamila Rekioua Ernest Matagne, "Wind Power Electric Systems- modelling, Simulation and Control", Green Energy and Technology, Springer 3. S. Sumathi ,L. Ashok Kumar , P. Surekha "Solar PV and Wind Energy Conversion Systems -An Introduction to Theory, modelling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques", Green Energy and Technology, Springer.	
Reference Books: 1. Gilbert M Masters., *Renewable and Efficient Electric Power Systems*, Wiley Interscience NeJ	

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Program: UG	**Semester: VII**	
Course Title: Smart Grid Technologies	**Course Code:17EEEE405**	
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. Introduction to Smart grid technologies Fully integrated power systems: Smart grids, Challenges in Smart grids implementation: Communication challenges in smart grids, Enabling Energy Efficiency, Overview of the technologies required for energy efficient smart grids, Threat and Impacts: Consumers and Utilities.	05 Hrs
Chapter No. 2. Communication technology in smart grids	10 Hrs

Control in power networks, Distribution Generation and Active Control, Overview of smart grid communication standards, Integration of Utility, Communication Networks and Smart Devices, Communication Technologies and Implementations, Cyber security, Interoperability, Case Studies.	
Unit - II	
Chapter No. 3. Smart Distribution systems and Energy Storage Smart metering, Real time energy pricing, Smart appliances, Distributed Energy Resources in Smart Grids, Demand response, Energy Storage Devices: Battery storage, Plug in hybrid electric vehicles, Compressed air, Pumped hydro, Ultra capacitors, Fly wheels and Fuel cells	07 Hrs
Chapter No. 4. Renewable Energy integration Integration of Intelligent Electronic Devices in EMS, SCADA and Substation Automation Systems Carbon foot printing, Micro-grid architecture, Modeling PV and Wind systems, Tackling Intermittency, Issues of interconnection, Protection and control of Micro-grid and sustainability protection and control of micro-grid, islanding.	08 Hrs
Unit - III	
Chapter No. 5. Smart and Efficient Transmission System Transmission Blackouts: Risk, Causes and Mitigation and Case Studies, Phasor measurement unit, Phasor data concentrators, Wide Area Monitoring, Protection and Control, Energy Monitoring systems and its applications in Smart grids, Flexible AC and HVDC transmission system.	05 Hrs
Chapter No. 6. Strategies for the future Energy efficient electrical networks Resources and Potential, Control and automation, BEE standards for Implementation of Energy Management System, Demand forecasting in smart grids, Prediction methods for secure power system operation, Dynamic tariffs, Market integration of the consumers.	05 Hrs
Text Books : 1. Bernd M. Buchholz, Smart Grids- Fundamentals and Technologies in Electricity Networks, Springer, 2014 2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage Jianzhong Wu Akihiko Yokoyama, Smart Grid : Technology and Applications, 1st edition March 2012, Wiley, 2012 3. Shady S Refaat, Omar Ellabbam, Sertac Bahyan, Haitham Abu-rub, Frede Blaabjerg, Miroslov M. Begovic, “Smart Grid and Enabling Technologies”, IEEE Press and Wiley, 2021.	
Reference Books: 1. A.B.M Shawkat Ali, Smart Grids: Opportunities, Development and Trends, Springer, Green Energy and Technology, 2013 2. Jean Claude Sabonnadiere, Nouredine Hadjsaid, Smart Grids, 1st edition, Wiley Blackwell, 2012	

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Program: UG		**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 - 1			
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: UG		**Semester : VI**
Course Title: CMOS VLSI Circuits		**Course Code: 19EEEE301**
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, MOS capacitance models. Transient Analysis of CMOS Inverter, NAND, NOR and Complex Logic Gates, Gate Design for Transient Performance, 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 McGra, 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: UG		**Semester: VII**
Course Title: AUTOSAR		**Course Code: 21EEEE402**
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 AUTOSAR Fundamentals Evolution of AUTOSAR – Motivations and Objectives AUTOSAR consortium – Stake holders – work Packages, AUTOSAR Partnership, Goals of the partnership, Organization of the partnership, AUTOSAR specification, AUTOSAR Current development status, BSW Conformance classes: ICC1, ICC2, ICC3, and Drawbacks of AUTOSAR.	08 Hrs
Chapter No. 2 AUTOSAR layered Architecture AUTOSAR Basic software, Details on the various layers , Details on the stacks Virtual Function Bus (VFB) Concept Overview of AUTOSAR Methodology , Tools and Technologies for AUTOSAR Application Software Component (SW-C) ,Types of SW-components AUTOSAR Run Time Environment (RTE): RTE Generation Process: Contract Phase, Generation Phase, MCAL, IO HW Abstraction Layer, Partial Networking, Multicore, J1939 Overview, AUTOSAR Ethernet, AUTOSAR E2E Overview , AUTOSAR XCP, Metamodel , From the model to the process , Software development process	07 Hrs
UNIT-II	
Chapter No. 3 Methodology of AUTOSAR and Communication in AUTOSAR CAN Communication, Application Layer and RTE, intra and inter ECU communication, Client-Server Communication, Sender-Receiver, Communication, CAN Driver, Communication Manager (ComM), Overview of Diagnostics Event and Communication Manager	10 Hrs
Chapter No. 4 BSW Development and Integration BSW Constituents: Memory layer, COM and Services layer, ECU abstraction, AUTOSAR, Operating system, Interfaces: Standard interface, AUTOSAR standardized interface, BSW-RTE interface,(AUTOSAR interface), BSW-ECU hardware interface, Complex device drivers and BSW module configuration, AUTOSAR Integration	05 Hrs
UNIT-III	
Chapter No. 5 Infotainment Systems in Automobiles Infotainment Systems Fundamentals: Radio, Multimedia, and Navigation: Introduction to In Vehicle Infotainment (IVI) systems, Use of operating systems in IVI , GENIVI Alliance, Tuner: AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio; Concepts of HD, radio, Ensemble, Traffic Announcements, Spread Spectrum, d. Multimedia: Types of Media; Music, Video, Podcasts, etc. Media management; Playback, Track Control, Metadata, Playlists, Categories, Trick play, Audio/Video Source Management, Navigation: Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS f. Media types: CD, DVD, CDDA, USB, SDCARD, Media Formats:MP3, WMV, RealAudio/Video, QTP, Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method	05 Hrs
Chapter No. 6 Communication Systems in Automobiles	05 Hrs

Automotive & Consumer Electronic Communication Systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN, Concepts of MOST network, DLNA, AVB, Concepts of TCP/IP, Ethernet, Wi-Fi, Wi-Fi Direct, MyWiFi and CAN, Mirror link, Tethering	
Text Books: 1. Ronald K. Jurgen, Infotainment systems, 2007, SAE International, 2007	

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Program: UG		**Semester : VIII**
Course Title: Embedded Linux		**Course Code: 19EEEE402**
L-T-P: 0-0-3	**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: Introduction to Embedded Linux: A Brief History of Linux -Benefits of Linux -Acquiring and Using Linux -Examining Linux Distributions - Devices and Drives in Linux-Components: Kernel, Distribution, Sawfish, and Gnome.	04 Hrs
Chapter No. 2: Overview of Embedded Linux: Overview: Development-Kernel architectures and device driver model- Embedded development issues-Tool chains in Embedded Linux-GNU Tool Chain (GCC,GDB, MAKE, GPROF & GCONV)- Linux Boot process.	05 Hrs
Chapter No. 3: System Management and user interface: Boot sequence-System loading, sys Linux, Lilo, grub-Root file system-Binaries required for system operation-Shared and static Libraries overview-Writing applications in user space-GUI environments for embedded Linux system.	05 Hrs
Unit - II	
Chapter No. 4: File system in Linux: File system Hierarchy-File system Navigation -Managing the File system –Extended file systems-INODE-Group Descriptor-Directories-Virtual File systems- Performing File system Maintenance -Locating Files –Registering the File systems- Mounting and Unmounting – Buffer cache-/proc file systems-Device special files.	06 Hrs
Chapter No. 5: Configuration: Configuration, Compilation & Porting of Embedded Linux-Examining Shells -Using Variables -Examining Linux Configuration Script Files -Examining System Start-up Files -Creating a Shell Script.	04 Hrs
Chapter No. 6: Process management and Inter process communication: Managing Process and Background Processes -Using the Process Table to Manage Processes -Introducing Delayed and Detached Jobs - Configuring and Managing Services - Starting and Stopping Services -Identifying Core and Non-critical Services -Configuring Basic Client Services -Configuring Basic Internet Services –Working with Modules. IPC-Benefits of IPC- Basic concepts-system calls-creating pipes-creating a FIFO-FIFO operations-IPC identifiers-IPC keys-IPCS commands- Message queues-Message buffer-Kernel Ring Buffer semaphores-semtools-shared memory semtools- signals-sockets.	08 Hrs
Unit - III	
Chapter No. 7: Linux device drivers: Devices in Linux- User Space Driver APIs- Compiling, Loading and Exporting- Character Devices- Tracing and Debugging- Blocking and Wait Queues- Accessing Hardware- Handling Interrupts- Accessing PCI hardware- USB Drivers- Managing Time- Block Device Drivers-Network Drivers- Adding a Driver to the Kernel Tree.	08 Hrs

Text Books :

1. Embedded Linux – Hardware, Software and Interfacing - Craig Hollabaugh, Addison-Wesley Professional, 2002

2.	Embedded / Real-Time Systems: Concepts, Design and Programming Black Book, New ed (MISL-DT) Paperback – 12 Nov 2003.

Reference Books:

1.	Building Embedded Linux Systems, Karim Yaghmour, First edition, April 2003.
2.	Embedded Linux- John Lombardo, Newriders.com

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Open Elective

Program: UG		**Semester : VIII**	
Course Title: Artificial Intelligence		**Course Code: 17EEEO402**	
L-T-P: 0-0-3	**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 : Introduction Introduction to AI, What is Intelligence? Characteristics of Intelligence Definitions of AI, History & Evolution of AI, Abilities of AI, Modeling of AI, Application of AI, Adv & Dis Adv of AI			07 Hrs
Chapter No.2 : Problem Solving Problem, Problem Solving, Problem Characteristics, Control Strategies, Problem search strategies, Data Driven & Goal Driven search, State space search, Goal & Game trees, Problem tree and Problem Graph, AND/OR Graph			08 Hrs
Unit - II			
Chapter No.3 : Knowledge and Representation Introduction, Definition and Importance of Knowledge, Knowledge based systems, Representation of Knowledge, Internal Representation, Prepositional Logic(PL) First order Predicate Logic (FOPL) knowledge organization, knowledge manipulation, acquisition of knowledge			08 Hrs
Chapter No.4 : Structured Representation Structured representation, Graphical representation, IS-ISPART Tree, Associative Network, Conceptual Graph, Linear Graph, Semantic Networks, Frames, Object Oriented Structure, Similarity Nets, Scripts			07 Hrs
Unit - III			
Chapter No.5 : AI Programming languages AI programming languages, Introduction to LISP: elements of LISP, Introduction to PROLOG and other programming languages.			05 Hrs
Chapter No.6 : Applications of AI Matching Techniques, Visual Image Processing, Pattern Recognition and Expert Systems.			05 Hrs
Text Books: 1. "Introduction to Artificial Intelligence and Expert systems" by D.W Patterson, Printice Hall of India, 1992.			
Reference Books: 1. "Artificial Intelligence" by Rich Elaine & Kevin Knight, Tata Mc Graw Hill, 1991. 2. "Principles of Artificial Intelligence" by Nils J Nilson, Berlin Springer- Verlag, 1980			

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